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THE NEW YORK DOCK BOARD plans have been approved by the Sinking Fund Commissioners for the improvement of the North River water front. The estimated cost is $11,327,640, and the plans propose the erection of five new piers ranging from 700 to 750 ft. long, and with slips between them 250 ft. wide, beginning near Charles Street and extending to Gansevoort Street, a distance of 8,963 ft., or about 1.7 miles of wharfage room. And they also provide for seven piers, each 800 ft. long, between Bloomfield and West 23d Streets; two other 800-ft. piers, flanking the ferry slips opposite West 13th St., and one pier, 800 ft. long and 50 ft. wide, on the north side of the Bloomfield Street, with a short pier and 403 ft. of available bulkhead space at West 22d Street. The aggregate wharfage room covered by the proposed improvement is 25,450 ft. or 4.82 miles, exclusive of the room occupied by the ferry slips. These new docks are urgently needed; and at the meeting Mayor Strong stated that a tramp steamer, having on board a cargo valued at $700,000, was lately compelled by the lack of suitable wharfage to lie in the stream at anchor for three weeks. It was also positively stated by Dock Commissioner Monk that the needs of this port had caused the organiation of an English syndicate which proposed to build 12 large piers, two drydocks and two ferries on the Jersey coast, north of Robbins Reef, with direct railway connections.

THE PORT ROYAL DRY DOCK is reported as ready for immediate service, the necessary dredging in the approaches having been completed on June 7.

THE STEEL STEAMER "JOHN ENGLIS," built for the Maine Steamship Co. by the Delaware River Iron Ship Building and Engine Co., at Chester, Pa., is on her speed trial trip to Portland, Me. The "Englis" is designed for a 16-knot steamer for coastwise service. She is 313 ft. long, 40 ft. beam and 21 ft. deep; her gross tonnage is 1,987 tons, and her engines develop about 4,000 I. HP., with 30, 48 and 75-in. cylinders and 54-in. stroke. Her single propeller is 16 ft. diameter and is a steel casting. She will carry 342 passengers and make her speed trial with 1,000 tons of freight on board.

A SPEED OF 34½ MILES PER HOUR is said to have been attained by the steam yacht "Ellide," designed by Mr. Charles D. Mosher, on a measured mile course at Dobb's Ferry, on the Hudson River, on June 14. The yacht was built at the shipyard of Mr. Samuel Byre, at Upper Nyack, N. Y., for Mr. E. Burgess Warren, of Philadelphia. It is an open boat, 83 ft. long, propelled by a single three-bladed screw, with quadruple expansion engines of 800-HP. A steam pressure of 250 lbs. was carried, and both wind and tide were unfavorable.

THE U. S. TORPEDO BOAT "PORTER" is making a series of official trial trips with a board of inspection aboard. The "Porter" made the circuit of Long Island, a distance of nearly 300 miles, in 12 h. 35 m. running time, and in the face of a strong easterly swell and a fresh wind. She also made a record of a mile in less than 2 minutes, and ran 42 miles in 1 h. 50 m. The official report of the trials will be interesting when it appears. In a later trial it was found the "Porter" could turn in a circle 1,100 ft. in diameter; and in reversing from full speed ahead to full speed astern, and vice versa, she took only 25 seconds and moved less than her own length before gaining motion in the other direction.

A POST GRADUATE COURSE in naval architecture has been established at the U. S. Naval Academy at Annapolis, Md., by order of Secretary of the Navy Long. Past practice has been to send graduates of the Academy assigned to the Naval Constructors Corps to England and France for instruction in the designing and building of vessels. These American students abroad usually won class honors, and the English authorities have of late discouraged the future education of Americans at their schools. In this emergency both Cornell University and the Massachusetts Institute of Technology offered their services for this special instruction. Secretary Long, however, thinks that this work should be done at a government institution, and in addition to the course established at the Academy he proposes practical work at the navy yards for the students in naval architecture. Naval Constructor R. P. Hobson, who was educated abroad, will be the head of the new department at Annapolis.

THE APPOINTMENT OF A CIVIL ENGINEER in the U. S. Navy is thus provided for in a circular issued by the Navy Department to fill an existing vacancy: Applicants must not be less than 25 nor more than 35 years of age; they must pass a satisfactory physical examination before a board of medical officers of the Navy, and must also pass a mental and professional examination before a board appointed by the Secretary of the Navy. Applications for a permit to be examined must be made to the Secretary of the Navy and these must be accompanied by testimonials of good moral character and evidence of American citizenship, and of having pursued a course of civil engineering at some professional institution of good repute, and of having had at least two years' practical experience as a civil engineer. The mental and professional examination will be competitive and the candidates who pass a satisfactory examination will be arranged by the board in order of relative merit. The examination will be in writing and include testimonials, English grammar and composition, elementary physics, elementary geology, drawing, arithmetic, general knowledge of algebra, geometry, trigonometry, analytical geometry, differential and integral calculus. Also applied mathematics, including mechanics of solids and fluids and strains in structures, constructional materials, engineering constructions, including workshops, chimneys, quay walls, wharves, dry docks, sewers, yard railways, pavements, water distribution, foundations, etc.; surveying, topographical, trigonometrical and hydrographical, and mapping same; instruments, their use and adjustments.

Candidates must present themselves before the board, of which Capt. A. H. McCormick, U. S. N., is president, at the Washington Navy Yard, at 10 a. m.,, on June 21, 1897. The other members of the present board are Assistant Naval Constructor R. B. Dashiell and Mordecai T. Endicott, Civil Engineer, U. S. N.

A NAVAL STATION AT SEATTLE, WASH., is proposed by Lieut. A. B. Wyckoff, U. S. N. (retired), whose plan is to utilize Lake Washington for this purpose, as this lake will soon be connected with Puget Sound by the ship canal now under construction. The navy department is considering the advisability of laying up war ships, instead of keeping them in commission, and with this in view, plans have been made for basins of about 15 acres at the League Island (Philadelphia), and Mare Island (San Francisco) navy yards. Lieut. Wyckoff advocates the selection of Lake Washington instead of constructing the Mare Island basin, as there is no tide, and the fresh water would cause but little fouling of the bottoms, while the cost would be but small as compared with the construction of a tidal basin.

CONTRACTS ON THE ERIE CANAL improvement, aggregating $2,873,852 in estimated value, will be awarded this summer, the plans having been approved. Of this amount $1,683,555 will be expended on the Eastern Division and $1,190,397 on the Middle Division. The contract work now under construction under the $9,000,000 appropriation amounts to $3,325,574; or $983,725 on the Eastern Division; $1,241,001 on the Middle Division, and $1,100,847 on the Western Division.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment of a passenger train on the Grand Rapids & Indiana R. R. at Stone Station, Ind., June 14. The engine, tender, mail car and baggage car were ditched, and the front truck of the smoking car also left the track. The engineman was killed and three trainmen were badly injured.

A GERDOM BREECH-BLOCK, fitted to a 3.2-in. rapid-fire field gun, burst at Sandy Hook on June 11, after 900 rounds had been fired with it. Mr. Gerdom, the inventor, says that the accident was probably due to the introduction of a new experimental cartridge; six of these had been fired, but the head of the seventh gave way, allowing gas to enter between the tube and jacket of the gun. No one was injured by the accident.

A FIRE AT ELLIS ISLAND, in New York harbor, in the early morning of June 15, destroyed the large but lightly constructed buildings of the government immigration station. There were comparatively few immigrants on the island at the time and there was no loss of life, but much personal property was destroyed, as well as valuable records of the immigration bureau. The buildings were of frame construction, sheathed with corrugated iron.

ARRESTS FOR RUNNING OPEN STREET CARS IN Brooklyn when the thermometer was below 60° F. have recently been made at the instance of the local Board of Health, which has an ordinance in force prohibiting this.

THE HARDIE COMPRESSED AIR CARS running on 121st St., New York city, have been in service for about ten months, making a total mileage of 28,444 miles, and carrying 100,272 passengers.

ELECTRIC RAILWAYS are making slow progress in Great Britain, according to the London "Electrician's" report of a discussion of a paper by Mr. A. K. Baylor entitled "Some Recent Developments in Electric Traction Appliances." It was stated that "there were only something like 80 miles of electric tramways or railways laid as yet." The English engineers claim, however, to have been several years ahead of the Americans in the adoption of direct coupled engines and dynamos. The outcome of the discussion, says the "Electrician," was a victory all along the line for American invaders, and it concludes an editorial on the subject in these words:

It is only natural that the American electric tractionist, having nearly annihilated the horse-car in his own country, should, like Alexander, sigh for more worlds to conquer; and we must take it as a delicate compliment that his missionary efforts are so largely directed towards showing the motherland the error of her tramways.

TWO ASPHALT PAVING CONTRACTS IN PHILADELphia have been declared illegal because the specifications called for Trinidad Lake or Bermudez asphalt or other lake asphalt equally good. Judge Pennypacker holds that "it is by no means certain that there is a fixed standard of quality for the asphalt of either of these lakes." The owners of these deposits could of course comply with the specifications without question, "but their possible competitors were left in entire uncertainty." The demand for lake asphalt the opinion upholds as within the power of the city. The contracts in question were awarded under an ordinance passed in June, 1896, authorizing the paving of 33 streets with asphalt. The contract for 16 streets was awarded to the Vulcanite Paving Co. at $1.95 to $2.14 per sq. yd., and for another 16 to the Pennsylvania Asphalt Co., at $1.90 to $2.12 per sq. yd., one street going to another company. The Alcatraz Paving Co. offered to do the work at $1.65 per sq. yd. This was the lowest bid, but was rejected on the ground that the company's asphalt did not comply with the specifications. A taxpayers' suit was brought to enjoin the award of the contract to the highest bidders, and this has just been decided as above. The decision does not maintain, so far as we can learn, that the contract in this case should have gone to the lowest bidder, but simply that the specifications should have been more definite.

THE DRAINAGE SYSTEM OF NEW ORLEANS has received at least a temporary setback by a decision in one of the lower courts against the constitutionality of the selection of the drainage commissioners otherwise than by the city of New Orleans, either through its officers or voting citizens. The case will go to the State Supreme Court.

A COMPRESSED AIR WORKERS' UNION has been organized in New York by the men employed in sinking caissons, foundations, etc., by means of compressed air. This union has fixed a scale of wages graded by the depth of the working chamber below the water surface. For example, at 50 ft., for an 8-hour day, $2.50 is demanded; below this depth the pay increases inversely with the length of the working day, until at 100 ft., about the limiting depth, the man is expected to work only 80 minutes in one day and to receive for this $3.75.

THE OFFICE OF SUPERVISING ARCHITECT of the Treasury, says Secretary of the Treasury Gage, will be filled by competitive examinations, conducted by the U. S. Civil Service Commission. This commission will avail itself of the advice and co-operation of a committee of architects of established reputation in the preparation of such questions as are intended to demonstrate the general and technical knowledge, skill and administrative ability of the various candidates for the office. The late incumbent, Mr. Aiken, technically holds office until July 30. Secretary Gage is also strongly in favor of public competition in securing plans for public buildings; and as the Tarsney act of Feb. 20, 1893, authorizes the Secretary to obtain plans in this manner, he has decided to give this statute, for the first time, a practical test at the first opportunity. This act, in the opinion of the Secretary and leading architects, should be amended so as to provide for the payment for the work of preparation of plans rejected; otherwise it would be difficult to induce leading architects to enter the competition. They will join in the first competition, however, trusting to Congress to later amend the law.

ESTHETIC DESIGN IN EUROPEAN BRIDGES.

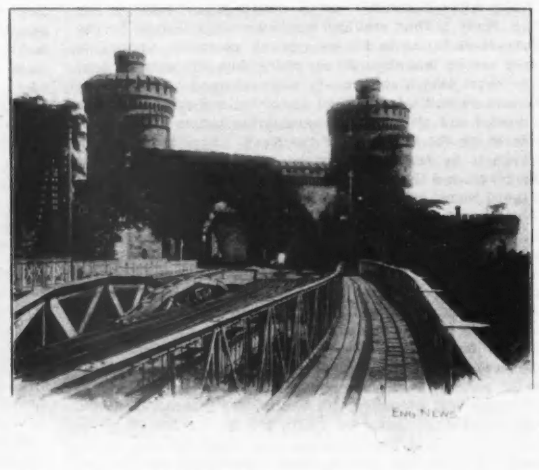
By Robert Grimshaw.

(With two page engraving.)

In America far too little attention is paid to the bridge considered as a decorative figure in the landscape. Too often (especially in the case of railway bridges) does the structure appear as a sullen streak across a smiling landscape, or as a rude scaffolding, shutting out more or less completely the attractive features of the view, or obtruding itself so completely that the attention is arrested thereby and refuses to leave the offensive element.

In striking contrast with this are the European —especially the Continental—bridges and viaducts which often have imposing portals and in no few cases are ornamented at each pier with statues or groups of a high degree of artistic merit. This

Portal of Karl's Bridge over the Moldau, Prague, Bohemia.



Portal of Railway Bridge at Mainz.

is not merely the case where bridges are of considerable importance as engineering works, but the principle extends down to minor structures; and not only where the position is one of importance, but in cases of relative insignificance as regards the neighborhood.

To illustrate more practically by photographic views than by a mere "say-so," I will commence by showing a short single-span iron bridge over one of the canals in the shipping district of Hamburg, a district built up of a curious medley of magnificent new warehouses or "Speicher," and century-old, low-ceilinged, many-storied buildings which do not fall down only because they are too crowded even to lean far. This "Kaiser Brucke" shown here, as seen from Dovenfleth, has handsome allegorical statues at the entrance which redeem it from being a simple plain wrought iron truss (with especially ugly tension members to support the floor) and make of it a decorative feature.

In the same city, the old bridge over the Elbe, with its curious (and uneconomical) "fish-belly" girders, making graceful reverse curves, has a simple but effective arched portal at each end, and by no means spoiled the landscape, or what little landscape there was. In the new bridge, over the same stream, and having the same type of girder, the portal is far more ambitious and decorative; and we note that it is planned for a future enlargement of the bridge to double width and carrying capacity.

If we cross the Rhine at Koeln (miscalling that city Cologne if we think proper), the railway bridge, while in itself particularly straight, monotonous, and unsatisfactory as an architectural element, is somewhat redeemed by the entrance towers, between which is a really good equestrian statue; and half-way over there are towers which break the view of the huge girder, and help greatly to atone for the propinquity of so commonplace a bridge to so wonderful a structure as the great "Dom," or cathedral.

If we journey to Mainz we find that the engineers of the bridge there, while selecting a very ordinary type of truss for their bridge, have been wonderfully helped out by the architects, in providing a handsome and imposing, not to say romantic, entrance, which not even railway tracks can ruin.

At Strassburg a plain lattice girder in three spans has been raised somewhat from the commonplace by so-called Gothic entrances, and simple pinnacles at the piers. (I say so-called because the Goths, so far from having any architectural style of their own, spent a large portion of their time in destroying that of other people. What most of us call the "Gothic" is really the "pointed" style.)

In the new Tower Bridge over the Thames at London, the engineer was confronted with practical problems which alone would have excused him, in America, for having made an exceedingly ugly structure; but as will be seen in the photograph, it is even possible to make such a prosaic thing as a lift-bridge "a thing of beauty and a joy forever."

Of course the graceful catenary lines of the link or rope suspension bridge aid, in themselves, to keep the structure from being a landscape-destroyer; yet the towers help greatly. The illustrations show two examples, chosen at random, that over the Elbe, between Bodenbach (Bohemia) and Tetschen (Saxony), and that over the Danube at the twin city of Buda Pest, Hungary.

Of the "rigid suspension" type there are as yet not many examples; and architecturally it is a "tough nut to crack." I show here the one between Loschwitz (where Schiller wrote "Don Carlos") and Blasewitz (who does not remember "Gustel aus Blasewitz?"), both suburbs of Dresden lying on the Elbe. Unfortunately for the landscape, this bridge (which is claimed to be the strongest in the world) is painted cobalt blue.

That noble portals are not necessary to beauty in a bridge, however, is attested by the structure at Coblenz, in which the roadway intersects the arcs of the girders on scant lines, instead of as chords, as in an under-road bridge, or as tangents in a deck design.

A very simple treatment of the piers, by building two of them up to the full height of the roadway, and capping the rest with pyramidal masonry, is effective, as seen in the old bridge over the river Main at Frankfurt. The view here given is taken from the right bank.

Carrying all the piers up to the roadway level, and making of their summits balcony-like resting-places is a frequent treatment, a good example of which is seen in the recently-finished Carola Brucke over the Elbe at Dresden. Here the effect is increased by pavilions at each end of the first land piers, and by ornamental obelisk-like lamp-posts at the others.

At Mainz we find a graceful handling of the piers and a very simple but effective entrance, in the new road bridge, as shown in the illustration.

Going to the capital of Germany, we are impressed with the liberal appreciation of the sculptor's art in the design of at least two of her bridges—that by the Schloss or imperial castle, and the Friedrich Brucke—the view of which incidentally shows the Bourse in the background.

If we take a journey to Vienna (which the Austrians have a habit of calling Wien, despite our usage), the Elizabeth bridge at once attracts our attention by the liberal use of statuary to accentuate, instead of conceal, the details of construction. What would otherwise be a short bridge, as much too wide in proportion as the Rhine bridge at Koeln is too long, is made an effective architectural ornament in a city by no means barren of noble and graceful instances of the builder's art.

But if Mainz shows how a romantic portal may redeem commonplace girders, and Dresden, Berlin and Vienna give examples of grace and beauty in pier-treatment, Prag, that city of a hundred and five towers, combines in her Karlsbrucke over the Moldau, the advantages and beauties of both methods. This massive stone arch bridge, connecting the main city with the "Mala Strana," or "Kleine Seite," on which is perched the magnificent Hradschin palace and the Cathedral of St. Veit, has each pier accentuated by a group of statuary, any one of the groups being worthy of a place in a public square, which the noble portal-towers with their great pyramidal roofs and their elaborately-sculptured facades, strike the visitor with wonder. This bridge is so wonderful—and also so famous—that I cannot refrain from giving several views of it. One shows the general treatment of arches and piers—the latter perhaps somewhat disfigured by ice-breakers a little on the upstream side, but massive and imposing.

Crossing this bridge from the main part of the city, we are confronted by a single tower with pyramidal roof, sharp turrets, florested decoration, and a simple, but graceful pointed arch, spanning the entire roadway. To the right is a fine statue of some dead and gone King or Kaiser, but this is but an accessory; the noble tower rivets the attention. As we cross, we find at each pier, on each hand, a statue or a group, well carved in stone, and of religious import; for we are in a Catholic land. One of these statues is disfigured by a commonplace housing or booth, with incandescent electric lights as a trimming. But it is by no means a modern, or a commonplace statue—for is it not the semblance of the holy Nepomuk, patron saint of Bohemia, and is it not gravely related that in some bygone war, when strong men "cut each other's throats for the love of God," when it was thrown over into the river it floated?"

Looking back at the entrance tower through which we passed we find its facade, while not so elaborately decorated with shields of many quarterings, the arms of proud bridge builders and destroyers of centuries of more or less distinguished (and less or more respectable) lineage—it is still noble and imposing; while straight ahead, on our way to the Hradschin, we find a widely different treatment. Two towers, of different heights and far different constructive and ornamental details, are connected by a short curtain wall, in which is pierced the archway. Bishops and saints, with dignified mien and impressive gesture, give us their blessings or their sanction, and remind us that we are going to the wonderful cathedral where the mortal remains of the holy Nepomuk repose in state in what is at once sarcophagus and monument—a silver masterpiece weighing, so say the guide-books (and there seems no reason to doubt them) two gross tons.

REASONS FOR THE LOW FUEL ECONOMY OF ELECTRIC LIGHTING STATIONS.*

By Fred R. Low, Assoc. M. Am. Soc. M. E.

In your last report you submitted returns from 81 electric light stations using coal as fuel, showing the following results obtained in actual practice:

	Watt-hours per lb. coal.	Lbs. coal per K-W.-hour.
Maximum	237	4.22
Minimum	33	30.3
Average	108	9.26

In your conclusions you call attention to the fact that at the Chestnut Hill pumping station, at Boston, an effective horse-power had been developed on 1.34 lbs. of coal per hour. If a steam dynamo can be constructed and operated as efficiently as was this steam pump, it will de-

* Condensed from a report to the Committee on Data of the National Electric Light Association.

liver 746 ÷ 1.34 = 557 watt-hours per lb. of coal, and require only 1,000 ÷ 557 = 1.8 lbs. of coal per kilowatt hour.

I am asked to account for this difference between the actual efficiency attained in the every-day practice of electrical stations and the efficiency apparently attainable in other applications of power.

In the first place, the standard which you have set is, purposely, no doubt, extremely high. The Chestnut Hill engine holds the world's record for steam efficiency, having developed an indicated horse-power on a consumption of 11.22 lbs. of steam per hour, and embodies all the refinements of modern engineering. There is no reason why an equally efficient engine can not be built and attached to a dynamo, should it appear advisable to incur the expense of all this refinement, for the attainable difference in expense of maintenance.

There are steam dynamos now running on 13 lbs. of steam per I. HP., which, with a difference of 15% between the indicated and electrical horse-power, and an evaporation of 10 lbs. of water per lb. of coal, would require

$$\frac{13 \times 1{,}000}{.85 \times 746 \times 10} = 2 \text{ (prox.) lbs. of coal per kilowatt hour,}$$

and deliver 500 watt-hours per lb. of coal; and these figures, actually attainable with existing steam dynamos for short periods under test conditions, are what should be compared with the record-making test of the pumping engine in your report.

Steam per HP. hour. Indicated.	Steam per HP. hour. Effective.	Equivalent[3] coal per K-W. hours.	Equivalent watt hours per lb. coal.
11.22	13.4[1]	1.8	557
13	15.3[2]	2	500

[1] Calculated from water pumped against pressure.
[2] Electrical HP., 746 watts.
[3] Calculated on evaporation of 10 lbs. water per lb. coal.

Thus reduced, the question becomes one of accounting for the difference between results obtained by a high-class engine, running under test conditions, and those obtained by an entire station, under running conditions involving not only the decreased efficiency of the units under unfavorable load conditions, but all the standing losses of the station, inferior fuel, etc. The difference will be made up mainly from the following items:

1. Decreased boiler efficiency.
2. Lesser normal efficiency of engine.
3. Impaired conditions of engines.
4. Unfavorable engine load.
5. Leakage.
6. Condensation.
7. Auxiliaries.
8. Heating.

Each of these separate causes is discussed by Mr. Low at length. We abstract only his conclusions as follows:

Under "Decreased Boiler Efficiency" he shows that the influence upon the economy of a boiler of running it at a considerable variation from its normal rating is very small, and he concludes that the influence of the variable load of an electric light station upon boiler economy has been much exaggerated. He finds, however, that when a boiler is laid off under banked fires it becomes a serious drag on the station. Hence, so far as economy is concerned, it appears to be better to force the boilers hard for the hour or so of maximum load than to keep boilers under banked fires to carry the load at that time.

Under "Lesser Normal Efficiency of Engine," he points out that an electric lighting engine which has to run when the demand comes, no matter what its condition, and cannot always be laid off for repairs when repairs are needed, cannot give as high economy as if it were in first-class condition.

Variation of engine loads is a factor of importance. An engine must run at low economy either when its load is rapidly changing or when it is running under a steady load materially less or greater than the load for which it can give maximum economy. Here is where good management by the Chief Engineer of a station comes in. He ought to know the most efficient load for each of his engines and see to it that as large a proportion as possible of the station's output is generated under these conditions.

Leakage is an astonishingly large factor with all classes of engines. The loss of water even from surface-condensing engines is well-nigh inexplicable.

The trials of the "Iona," by the Research Committee of Mechanical Engineers, showed that the quantity of water required to make up leakage was about 6% of the total feed, although, beyond a slight leakage at the feed-pump gland during a portion of the trial, there was nothing apparent to the many observers which would account for such a loss.

Condensation from the piping, etc., represents a large loss of heat. Only 15 sq. ft. of bare pipe surface exposed are sufficient to use up a horse-power of steam.

Auxiliary engines about a station often use large amounts of steam, even though they develop small amounts of power. Heating the station, offices, etc., even when done by exhaust steam, means often a back-pressure on the engines. The paper concludes as follows:

In the following table, I have undertaken to show, for the few stations from which reliable data have been procurable, the proportions which the various demands upon the coal pile bear to each other and to the whole. The column headed "efficiency" shows the percentage of the coal actually used that would have been used by the standard equipment (10 lbs. of steam per hour and the electrical horse-power 85% of the indicated). Under "engines" is the percentage of the total coal consumed by reason of the lesser efficiency of the engines; under "conversion," the percentage of the coal consumed by reason of the conversion losses exceeding the standard. The next three columns give the percentage of the total coal used to supply leakage, condensation and auxiliaries. The column under "boilers" gives the percentage by which the consumption was affected, by reason of the fact that the boilers evaporated more or less than 10 lbs. of water per lb. of coal, while the column of "unassigned" gives the aggregate of all the losses not separately reported.

No.	Hours Run.	Results. Lbs. coal per kilow't hour.	Results. Watt hours per lb. coal.	Results. Efficiency per cent.	Percentage of Coal Used for. Engines.	Conversion.	Leakage.	Radiation.	Auxiliaries.	Boilers.	Unassigned.
1	24	8.30	120.5	24.09	20.05	.24	....	....	....	19.91	34 79
2	6-12	6.24	160.3	32.05	27.30	3.03	....	....	....	26.98	10.04
3	24	3.71	269.5	53.91	9.03	....	11.63	....	....	19.95	5 45
4	24	4.56	219.7	43.86	5.88	2.13	<—12—	>	....	25.00	23.11
5	23	8.69	115.1	23.01	24.97	6.95	.....	.....	.....	.4	32.66
6	24	3.82	262.	52.10	8.80	5.03	.....	4.00	....	..	30.07
7	24	8.91	112.2	22.45	22.56	5.50	.....	.....	....	18.60	10.89
8	14-20 Av 17	8.67	115.3	23.07	....	.....	.....	.....	6.04	39 60	31.28
9	24	6.64	150.6	30.12	30.12	21.50	.....	.....	....	1.70	17 56
10	24	8.62	116.	23.20	24.12	7.5	.....	.....	....	1.50	43.67
11	24	10.13	98.7	19.74	9 27	.....	.....	.....	....	42 50	28.49
12	24	7.45	134.3	26 85	35.23	.....	.....	.....	....	-13.60	48.53
13	12	7.33	136.5	27.29	11.45	.....	.....	.....	....	25.00	36.26
14	24	5.68	176.2	35.21	10.64	1.07	.....	.....	5.30	10.00	37.77

LIGHTING DARK ROOMS BY REFLECTION.

An interesting exhibit of a method of lighting the rear portions of imperfectly-lighted rooms, such as long storerooms, fronting on a narrow street and having windows only in front, is being made by the Luxfer Prism Co., at 24 Beekman St., New York city, 170 Lake St., Chicago, and 58 Yonge St., Toronto, Canada. The general office of the company is in the Rookery Building, Chicago. The system consists of a window built up of sections of plate glass, one side of which is formed of a series of parallel horizontal prisms each about ½-in. in depth. The daylight is received in a nearly vertical direction from so much of the sky as is visible in the narrow street or well, into the upper horizontal side of the prism, and is reflected by the inclined side in a horizontal direction through the room. Long basements or cellars which receive light only through sidewalk vault lights are also lighted by prismatic blocks of glass inserted in the iron framework of the vault lights. The light received from these vault lights is first transmitted

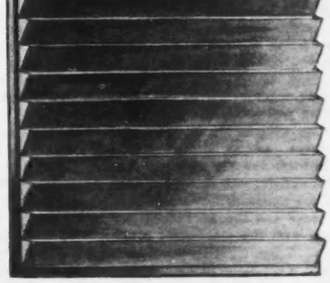


Fig. 1.—Prism Plate Glass for Windows, Made by the Luxfer Prism Co., Chicago.

downwards at an angle and is then further reflected in a horizontal direction by a vertical screen of horizontal prisms. Fig. 1 represents one of the sections of the vertical windows, and Fig. 2 one of the prismatic blocks used in the vault lights.

The effectiveness of this system of lighting long storerooms and basements, as witnessed by a member of the staff of this journal at the exhibition in New York city, is quite surprising. The room at the level of the street is provided with ordinary windows, inside of which are hinged two of the prismatic screens, covering the upper half of the windows. When the screens are folded back so

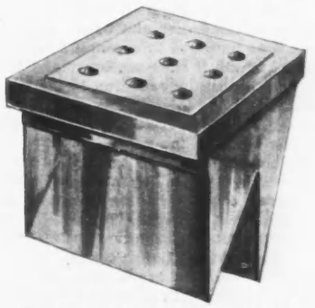


Fig. 2.—Luxfer Prism for Vault Light.

that light comes through the ordinary windows only, the rear of the room is very poorly lighted, but on covering the upper half of the window with the prismatic screens a flood of light is thrown to the rear. A similar increase of light is made in the basement, which is ordinarily lighted by a sidewalk light, when the prismatic screens are put into the proper position.

The angle of the reflecting side of the prism has to be proportioned to the angle at which daylight is received, and therefore prisms of many different angles are made to suit different locations. In fitting a room with the prismatic windows a survey is first made to determine which angle of prism is most suitable.

The inventor of the system is Mr. James G. Pennycuick, of Toronto. The Luxfer Prism Co. has acquired his patents, and has employed Prof. O. H. Basquim, formerly professor of physics at the Northwestern University, to work out the scientific problems involved, which involve the laws of optics and experimental determinations of the reflecting powers of different kinds of glass. The company has also secured control of patents for the Winslow system of electric glazing, by means of which the sections of prismatic plates are built into windows. The edges of the sections are fitted with copper strips which are joined together by electric brazing, the result being a much stronger construction and one obstructing the light much less than the ordinary method of making leaded glass windows.

TESTS OF VARIOUS FORMS OF BRACING FOR WOODEN TIMBER BENTS.

A series of experiments upon the relative strength of different forms of bracing of timber bents were recently conducted, under the direction of Prof. Edgar Kidwell, of the Michigan Mining School, by Messrs. E. W. Durfee and Frederick P. Burrall. The results of these tests are published in full in Vol. IV. of the Proceedings of the Lake Superior Mining Institute.

In these tests the principal members were not less than 4×4 ins., with bracing of proportionate size. The sill of the bent was securely anchored, and a thrust was applied to the caps, tending to force the bent over in its own plane, and the relation between the amount of yield and the force producing this yield was measured with provision against sidewise movement. The stress was applied by means of a 100,000 lb. Riehle testing machine, in a manner fully illustrated and explained in the original article. All bents tested were of the same inside dimensions, or 6 ft. high and 6 ft. between posts; they were carefully made of 4×4 in. white pine taken from the same stock and built by the same man.

In Bent No. 1, the cap and sill were 12 ft. 8 in. long, and the braces were 2 × 4 in. white pine, with 2 in. dimension in the plane of the bent. The braces were cut to a driving fit into notches in the posts, cap and sill, and in each end of the braces were driven two 3½ in. No. 12 wire nails. The posts were mortised into the cap and sill, and

held by ½ in. oak pin at each joint. Bent No. 2 differed from No. 1 in the position and fastening of the braces; these were placed with the 4 in. dimension in the plane of the bent, with 1½ in. tenons let into mortises in cap, sill and posts, secured by ½ in. oak tree nails. Bent No. 3 had a cap and sill only 8 ft. 8 ins. long, with all bracing on the inside of posts. There were two 3 × 3 in. diagonal white pine braces, extending from sill to cap, halved at the center and bolted at this joint; the posts were mortised to cap and sill. Bent No. 4 had cap and sill 9 ft. 2 ins. long, and the eight corners were braced by cast-iron knees, each held in place by eight ⅜ × 5½-in. bolts. In this case the posts butted square against cap and sill, fastened only by the bolts in the knees. Bent No. 5 only differed from No. 4 in the form of the knees, the latter having ½ × ½ in. lug at each end. Bent No. 6 differed only in having the lug at the center of the leg of the knee. Bent No. 7 was peculiar in having a form of brace not hitherto used for wooden bents in the Lake Superior region. This is a cast-iron T-section brace, with the ends terminating in a shoe with a lug at the toe. The shoe was wider than the brace itself. The claimed advantage of this form of brace is that it can be set up tight by driving the spikes or tightening the bolts when these are used; and the lug prevents sliding along the timber. In this bent the posts were fastened to the sill and cap by two ⅜ × 5½-in. bolts at each end, passing through the cap and sill and screwed into nuts boxed into the posts. In Bent 7a, the connection betweeen cap and sill and the posts was made by a ⅝ × 8 in. lag-screw instead of by bolts.

Prof. Kidwell states that these tests covered the forms of bracing in most common use in the copper mining district. No. 2 is the most common in all forms of framed structures. No. 1 is used at the Huron Copper Mine in the stamp mill, and in the shaft-house and stamp mill of the Centennial Copper Mine. It is cheaper than No. 2, can be made to a tight driving fit at the beginning and can be wedged up tight when loosened by shrinkage. No. 3 is little used in the Lake Superior mining districts. Iron knees were introduced some years ago to avoid the evils due to the shrinkage of the braces, and they are now extensively employed at the Calumet and Hecla and the Tamarack mines, No. 6 being the ordinary form.

The following summary of the conclusions reached from the tests will indicate the comparative merits of the several forms of bracing tested:

1. Form in Bent No. 1 can be made tighter on the start than No. 2, but the latter has the greater ultimate strength.
2. No. 3 is a rigid form if the forces tending to distort it are very moderate, but it cannot stand heavy stresses.
3. No. 5 is a rigid form under moderate loads, but cannot stand heavy loading.
3. Nos. 1, 2 and 3, show greater strength and rigidity accordingly as they are more heavily loaded on top.
4. No form of iron knee tested gave a very rigid bent, as the latter had to be deflected more than could be allowed in practice, before the bents exhibited much strength.
5. If iron knees are used, it is better to use the plain pattern, instead of the usual form provided with lugs or cogs.
6. The brace in No. 7 gives a more rigid structure than any of the iron knees, and when merely spiked on is strong enough for any structure not subject to heavy shocks.
7. This brace when reinforced with bolts is probably better than any form now in use, as evidenced by test on 7a.
8. There are reasons to believe that this brace can be so designed that, apart from its greater efficiency, it will in the end be as cheap as the iron knees.

We advise any of our readers interested in this subject to procure a copy of the report of these tests, which has been reprinted from the "Proceedings of the Lake Superior Mining Institute" in a separate pamphlet. Copies can probably be obtained by application to Professor Kidwell, Houghton, Mich.

OIL FOR LAYING DUST on track ballasted with gravel and cinders is being used on the West Jersey & Seashore R. R. Mr. J. H. Nichols, Assistant Engineer, informs us that this plan has passed the experimental stage, and that they are only waiting the completion of a car for distributing the oil mechanically to cover all dusty places on the road. At the present time there are about four miles of track so treated. The rails are kept clean by means of a shield. The result obtained is a complete freedom from dust at points which were formerly the most dusty on the division. The spraying will be required but once a season after the renewal of ties. When it becomes necessary to disturb the track for repairs it will probably be necessary to spray again, but it is thought that after not more than three applications the ballast will be impregnated with the oil to a sufficient depth to render subsequent treatment unnecessary. The oil is of a special kind, having two properties fitting it for this use: (1) it is penetrating and tenacious, and (2) it is not combustible as used, but can only be burned by converting it into a spray almost resembling a gas in fineness; it is almost without volatile ingredients and has therefore but little odor (and that not of an unpleasant character), even when first applied, and this odor decreases on exposure. The oil can be distributed in place at a total cost of less than $50 per mile of single track.

ENORMOUS TANK ENGINES, of 103 tons weight, have been built by the Hyde Park Locomotive Works, of Glasgow, Scotland, for the Mushkaf-Bolan Division of the Northwestern Railway (State Railways), of India. This line, which was described in our issue of July 12, 1894, has curves of 600-ft. radius and grades of 4%, up which latter grade one of these engines will haul a train load of 220 tons exclusive of the weight of the engine. They have outside cylinders, eight coupled driving wheels (the third pair being the main drivers), and a single pair of leading and trailing wheels, each carried on a radial axle. Sand jets are fitted for the outer and main driving wheels. The Laird type of crosshead is used, and the main and side rods are of I-section. The boiler has an extension smokebox, and the tanks are placed on each side, with a small coal bunker behind the enclosed cab. As in that climate the water in the tanks becomes too hot to feed by injectors, a feed pump, capable of working with water at 180° is fitted in addition to the usual injector equipment. These engines are almost the heaviest engines in the world, the total weight being 206,276 lbs., with 155,932 lbs. on eight driving wheels. The Johnston compound duplex engines on the Mexican Central Ry. weigh 230,000 lbs., with 200,000 lbs. on twelve driving wheels. The tank engines working the St. Clair tunnel weigh 195,000 lbs., all of which is carried on ten driving wheels. The Indian engines run on a track laid with 100-lb. rails on the heavy grades, and the general dimensions of these engines are as follows:

Driving wheels	4 ft. 3 ins.
Wheel base, rigid	16 " 0 "
Wheel base, total	31 " 3 "
Weight in working order:	
On leading axle	19,376 lbs.
On first driving axle	39,004 "
On second driving axle	39,004 "
On main driving axle	39,088 "
On fourth driving axle	38,836 "
On trailing axle	30,968 "
On driving wheels	155,932 "
On leading and trailing wheels	50,344 "
Total	206,276 "
Cylinders	20 × 26 ins.
Boiler pressure	180 lbs.
Grate area	30.22 sq. ft.
Heating surface, tubes	1,942.00 " "
Heating surface, firebox	148.00 " "
Heating surface, total	2,090.00 " "
Capacity of tanks	2,640 gallons
Capacity of bunker	190 cu. ft.

A MASONRY VIADUCT, 1,800 ft. long, has recently been built at Mussy, France, by the Paris, Lyons & Mediterranean Ry. for its new line from Paray-le-Monial to Lozanne and Givors. There are 18 semi-circular arches of 82 ft. 2 ins. span, and at the deepest part of the valley the rail level is 197 ft. from the ground. The piers are 16 ft. 5 ins. × 34 ft. 8 ins. at the springing line, except three, which are 23 ft. × 34 ft. 8 ins. The piers have a batter of 1 in 40 on the wide faces, and 1 in 20 on the narrower faces. The arches are 26 ft. 6 ins. wide. The concrete filling above the arches has a concave surface to receive the ballast. The rails are level with the coping, and an iron railing is built along each side. The stone was brought by a special railway line from quarries 5 miles distant, and all material was handled by cars on an extensive system of narrow gage tracks. As no sand could be obtained conveniently, the decomposed granite of the district was used, being crushed, screened and washed by special machinery. In the erection of the piers no scaffolding was used, but platforms were built 88 ft. long and 10 ft. wide, supported by girders resting on jacks on the piers. Each platform could carry a load of 6 tons at the middle, and had two tracks of 19¾ ins. gage, with crossings and turntables for handling the stone. When the limit of the platform was reached, the girders were raised by the jacks and the work then proceeded with. At the springing level the piers were connected by five steel cables, 5 ft. 5 ins. apart, on which was laid planking, so as to form a series of flying bridges. When the arch centerings had all been erected, a light trestle, 10 ft. wide, was erected for the whole length of the viaduct above the piers and centerings, and on this were two tracks of 20 ins. gage for transporting material. The stone, etc., was delivered at the base of the viaduct and hauled up an inclined plane on the slope of the valley to the level of the trestle. This was done by a 25 HP. hoisting engine, which also hauled the cars on the trestle tracks. The engineers for the railway company were Messrs. Geoffroy, Moris and Ponthier. The contractors were Messrs. Vaysserye.

THE SHONE SYSTEM OF LIFTING SEWAGE is to be used at Far Rockaway, N. Y., where three stations will have a daily capacity of 1,584,000 gallons. Within a few years past the Shone system has been installed at Fair Haven, Lynn, and Worcester, Mass. (the latter for sludge at purification works); Ithaca and White Plains, N. Y.; Portsmouth, Va.; Charleston, S. C.; Chicago, Ill.; and Winona, Minn. The largest plant is at Portsmouth, Va., and has a capacity of 3,750,000 gallons a day. None of the plants have less than 720,000 gallons capacity. A number of the plants have the air compressors located at water-works or electric light or power stations, thus effecting an economy in operation. Most of the ejectors serve only partial sections of the respective cities, too low for gravity sewers. The above information was sent, at our request, by Mr. Urban H. Broughton, Assoc. M. Inst. C. E., Engineer and Manager of the Shone Co., Isabella Building, Chicago. In our issue of Aug. 4, 1892, there appeared an extract of a paper by Mr. Isaac Shone, describing the Shone system and its applications in detail. The Shone plant of 26 ejectors at the World's Columbian Exposition was described in our issues of March 25 and July 27, 1893.

THE REBUILDING OF BOMBAY, INDIA, is being seriously discussed by the authorities of that city. They believe that the opening up of new and broader streets and the pulling down and rebuilding of unwholesome habitations are the best and cheapest means of preventing spread of disease in that city. An estimate submitted to the municipality puts the cost of work proposed at $10,000,000, and it is believed that the money can be borrowed in England at 3¼%, provided that the principal and interest are guaranteed by the government or the city of Bombay.

THE GREATEST DENSITY OF POPULATION IN THE world, says the "Indian Engineer," is claimed for Bombay, and is only disputed by Agra. The population of Bombay amounts to 760 persons per acre in certain areas and in these sections the street area only occupies one-fourth of the whole. If the entire population massed in the streets for any purpose the density would equal 3,040 persons per acre.

THE WILL OF THE LATE ALFRED NOBEL, of nitroglycerine fame, who devoted the bulk of his fortune to the advancement of science, is thus abstracted by U. S. Minister Ferguson, of Stockholm, in the part relating to distribution of prizes: Mr. Nobel left between 30,000,000 and 35,000,000 kroners, which, at 3% would yield from $240,000 to $270,000, to be annually distributed in five equal prizes; though, it is also said that heirs are contesting the will and it may be some years before the executors can perform their duties under the will. By the terms of the Nobel will one prize goes to the person having made the most important discovery or invention in the science of physics; a second prize to him who has made the most eminent discovery in chemistry; a third for the most important discovery with regard to physiology or medicine; a fourth prize to the one producting the most distinguished idealistic work of literature, and a fifth prize to the person who has worked the most or best for advancing the fraternization of all nations and for abolishing or diminishing standing armies and promoting peace. These prizes are to be awarded as follows: For physics and chemistry, by the Royal Swedish Academy of Science; for medicine, by the Carlinska Institute at Stockholm; for literature, by the Royal Swedish Academy, at Stockholm, and for the propagators of peace by a committee of five selected by the Norwegian Storthing. All nations are invited to compete. Minister Ferguson says that he has received many letters from students and investigators in the United States and he publishes this answer as embodying about all that is known concerning Mr. Nobel's bequests at the present time.

THE COAL PRODUCTION of the United States for 1896, according to compilation made by Mr. E. W. Parker, statistician of the U. S. Geological Survey, amounted to 190,639,959 short tons (2,000 lbs.), valued at the mines at $195,557,649; against 193,117,530 short tons, valued at $197,799,043 in 1895. The amount of coal mined in Pennsylvania was 53,771,890 tons anthracite and 49,101,148 tons bituminous. The average price obtained for anthracite at the mines increased from $1.41 in 1895 to $1.51 in 1896, while the average price for bituminous decreased from 86 cts. to 83 cts. Illinois is second to Pennsylvania, with nearly 20,000,000 tons, and Ohio and West Virginia mined each nearly 13,000,000 tons. Alabama comes next with nearly 6,000,000, then Maryland, Indiana and Iowa with about 4,000,000 each. Kentucky mined a little over 3,000,000, and Kansas, Tennessee and Missouri each mined over 2,000,000. Wyoming and Nebraska are taken together and credited with over 2,000,000 tons, and Virginia, Montana, Indian Territory and Washington each produced over 1,000,000 tons. The states which produced coal in smaller amounts are Arkansas, New Mexico, California and Alaska, Georgia and North Carolina, Michigan, North Dakota, Oregon, Texas and Utah.

The total figures for the United States agree quite closely

with those given in Rothwell's "Mineral Industry," Vol. V., which we gave in last week's issue, viz., 187,373,577 short tons.

A NEW STEAM METER.

We illustrate herewith a new steam meter, which has been recently patented by Mr. G. C. St. John, vice-president of the New York Steam Co., 2 Cortlandt St., New York city, and has been put in use by that company for measuring the steam supplied to its customers. Fig. 1 is an exterior view of the complete apparatus, including the registering apparatus and a trap for draining the water of condensation out of the steam before it reaches the meter. Fig. 2 is a sectional view, and Fig. 3 is a diagram showing the method used in standardizing or calibrating the meter. The principle upon which the meter works is thus explained: A heavy, long vertical conical-shaped plug, with a slight shoulder at about the middle of its length, forms a valve which closes a circular opening in a horizontal plate which divides a steam chamber into two parts, upper and lower. When the steam pressure is the same above and below the division plate the plug closes the opening and no steam passes through. When the pressure above the plate is decreased to such a point that the unbalanced pressure acting upon the valve just exceeds the weight of the valve it will rise, opening the hole and allowing enough steam to pass through to keep the difference in pressure acting on the valve above and below the opening at an amount which will keep the valve floating in the ascending current of steam. With a constant pressure of steam supplied to the lower chamber and a constant outflow from the upper chamber the valve will take and maintain a constant position; if the outflow is increased the valve will take a higher position, so as to increase the area of the annular opening between the valve and its seat. If the lower portion of the valve were made truly conical the rise of the valve would not be strictly proportioned to the flow of steam, and its outline is, therefore, made slightly curved; the form of this curve is determined for each size of meter by experiment, and the curve is such that the rise of the valve is directly proportioned to the quantity of steam which flows through the opening. The amount of rise of the valve is registered by means of a pencil, carried at the end of a bell-crank lever and resting upon a slip of paper which is moved by clockwork at a uniform rate.

Referring to the sectional view, Fig. 2, the steam enters the meter at G, passes through a circular bushing in the plate at 23, lifting the valve 11, which is held in a vertical position by round bronze rods passing through holes in plates above and beneath at O and 20. On the lower end of the rod, at C, is attached a round plate working in a dashpot, C Fig. 1, which is kept full of water and which checks vibrations of the valve. The vertical motion of the valve is communicated to the paper diagram by means of lever 7, which rocks a pivot 14, the connection between the moving end of the lever and the valve being made by a steel pin, 22, in the lever engaging with a circular slot, 21, in the upper part of the valve 11. The pivot, 14, of the lever is seen also at L Fig. 1, projecting outwards from the hollow casing D, through a stuffing box, and has at its extremity a very light arm E, which carries a pencil that makes a mark on the paper T, driven by the clockwork V.

The operation and registration of the meter depend upon four factors: 1, gravity acting on the valve; 2, pressure of the steam below the valve; 3, time, which is registered by the clockwork and the travel of the paper; and 4, aperture for the passage of steam, which depends upon the position of the valve with reference to its seat.

The method of calibrating the meter is to attach it to a surface condenser of a size sufficient to condense all the steam which will pass through the meter when the valve is open to its full limit. The steam outlet is throttled so as to allow a fraction of the total capacity to pass through, sufficient to cause the pencil to make a mark on the diagram, say ¼-in. above the base line, or line drawn when the steam is shut off. The amount of steam flowing is determined by weighing the amount that is condensed during a given interval of time, say 15 minutes, and the height of the line drawn on the diagram is carefully measured. A greater amount of steam is then passed through for another period of time, and the weight and the corresponding height of the diagram again recorded, and so on until several tests have been made for different rates of flow. The records are then plotted on cross-section paper and the rate of the meter is calculated from them. The diagram, Fig. 3, shows the plotted record of such a series of tests, and the record from which it is plotted is shown on the figures adjoining; thus with an opening shown on the traveling paper to be 0.36-in., the amount of steam flowing, as determined by weighing the water after condensation, is 490 lbs. per hour; for an opening of 0.68-in. the rate of flow is 965 lbs. per hour, and so on, up to an opening of 2.12 ins., giving a flow of 2,980 lbs. per hour. As is seen in the cut, the diagram plotted from these records is a straight line, and from it the rating is found to be 1,400 lbs. per hour per inch of height of the mark made by the recording pencil. The roll of paper moved by the clockwork is sufficient to last a week, and it has marked upon it the position of the hours and fractions of an hour, so that to measure the consumption of steam during any period of time, such as a day or a week, the average height of the pencil mark is taken, and this is multiplied by the rate of the meter per inch of opening per hour, and by the number of hours.

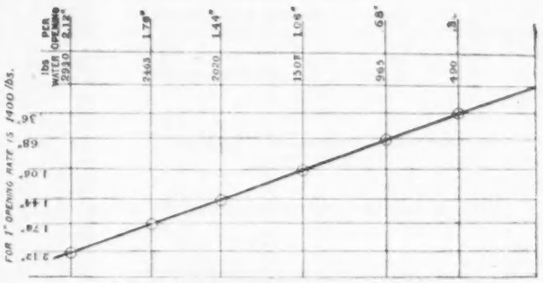


Fig. 3.—Diagram of Tests of a Steam Meter.

In using the meter the following precautions should be taken, according to the directions given by the inventor, referring to Fig. 1:

The meter must be set strictly perpendicularly.

When the meter is in action, valve G should be left wide open.

To shut down the meter, close valve H.

To bypass steam, close valves G and H, and open valve I.

Before turning on steam, the casings S and B should be relieved of water of condensation by opening the valves K and J.

When turning on steam, if there is a valve between H and point of consumption, it should be kept closed, and the valves, I, H and G, opened in order named. This will prevent any sudden action of valve 11, due to condensation when the meter is cold.

When the meter is hot and casings drained, close valve I slowly, which will cause all steam used to pass through the meter.

The dashpot C should be blown occasionally at petcock N, in order to guard against sediment, which comes from dirty pipes. The blowing should be done fifteen minutes before opening the valve H, in order to permit dashpot to fill with water, which insures the meter against sudden movement.

The meter is at present made in four sizes, for 1½, 2, 3 and 4-in. connections, respectively.

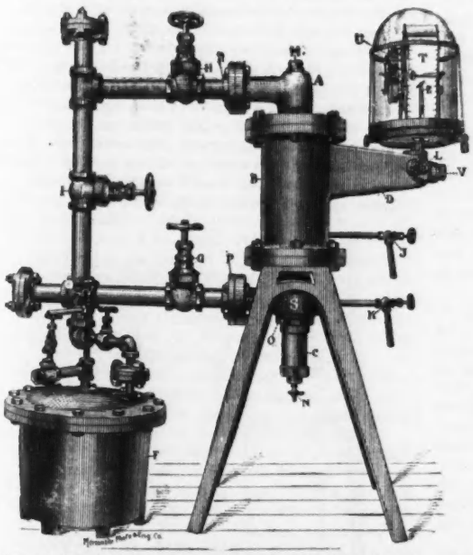


Fig. 1.—Steam Meter. Patented by G. C. St. John, 2 Cortlandt St., New York City.

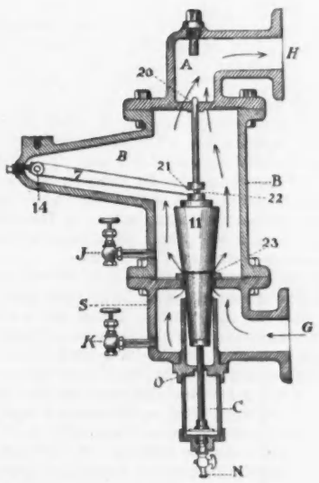


Fig. 2.—Steam Meter. Sectional View.

THE FAILURE OF THE BROWN SOAP FACTORY BUILDING IN NEW YORK CITY.

On p. 368 of last week's issue we gave an account of the fall of a portion of the new soap factory of David S. Brown & Co., at 12th Ave., 51st and 52d Sts., New York city, which took place on June 3, killing two men. The coroner's inquest has not yet been held, the debris of the wreck remains in the condition that it was left after the search for the bodies of the victims was ended, and consequently it is impossible yet to determine at what point the first break took place, or what was the immediate cause of the fall. Enough is known, however, to prove that the building was essentially defective in design, and that it was a highly dangerous structure.

The sketch, Fig. 1, illustrates the form of the iron and steel skeleton of the building. Below the level of the cellar floor we have at present no information concerning the foundation system, and until the debris is cleared away it cannot be known whether or not there was any settling of the foundation, which might have been one of the contributing causes of the accident. Above the cellar floor are supporting piers of brickwork well laid in cement, each surmounted by a 12-in. granite cap stone, on which rests a heavy cast-iron base 15 ins. deep, to which the bottom of the column of the first tier is bolted. Up to this point everything seems to be well designed and built. Above the first floor level the skeleton of the structure contains two rows of square cast-iron columns, one in each of the exterior walls, and two interior rows of cylindrical cast-iron columns. The rows are approximately 19 ft. apart, c. to c., and the columns in each row are 16 ft. 7 ins. c. to c. Floor girders, consisting of 15 and 20-in. I-beams rest on lugs cast on the columns, and each is further fastened at each end by three ¾-in. bolts to a side lug (not a pair of lugs, as stated in last week's issue) cast on the column. This construction is shown in Figs. 2 and 3. The floor girders carry the floor joists, which are 4 × 12-in. timbers. On the fourth floor in two of the three sections into which the building is divided by the four rows of columns, the floor construction above described is departed

from on account of the weight of the tanks supported on this floor, and heavy 24-in. I-beams, with top and bottom flanges each re-enforced with two ⅝-in. plates, are used to span the space between the two rows. Crossing the space between these girders are six 15-in. I-beams which take the place of the usual timber joists, and support the flooring upon which is placed the tanks. The

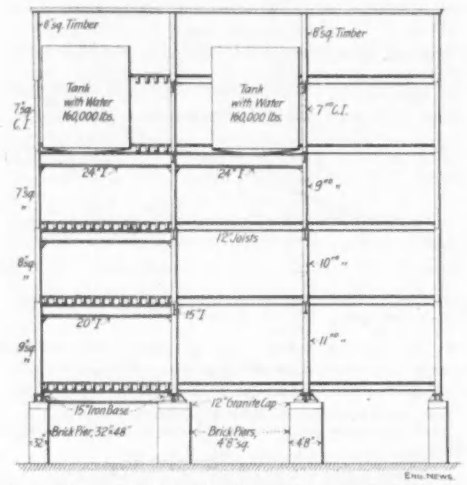


Fig. 1.—Cross Section of Portion of D. S. Brown & Co.'s Soap Factory, 12th Ave. and 51st St., New York City.

dimensions of the cast-iron columns on the several floors are as follows:

	Exterior columns.	Interior columns.	Length.
1st floor	9 in. sq.	11 in. round	12 ft. 6 ins.
2d "	8 " "	10 " "	10 " 6 "
3d "	7 " "	9 " "	10 " 6 "
4th "	7 " "	7 " "	10 " 6 "
5th "	All wooden columns, 8 ins. square.		

The method of attachment of the floor girders to the cast-iron columns was the same in all cases, as shown in Figs. 2 and 3, the dimensions being practically the same in all. The method of attachment of the columns to each other is also shown in Fig. 2. The flimsiness of this joint and its inability to resist any side strain applied on the side on which the lug is cast is apparent.

Thus far we have not mentioned the exterior brick wall. Its position with reference to the cast-iron columns is shown in the plan view in Fig. 4. It is carried up from the ground to the level of the 4th floor 16 ins. thick, and above that level 12 ins. thick. It does not contribute in any manner whatever to the support of the floors of the building, and is nothing but a curtain wall; having nothing to do but support its own weight and keep out the weather. The only attachment of it to the floor system is by means of clips made of 2 × ¼-in. iron at each column joint, held to the column by a

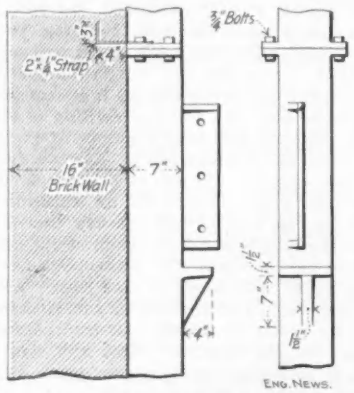


Fig. 2.—Fastenings of 7-in. Square Cast Iron Columns.

single ¾-in. bolt. The arrangement of the clip is shown in Fig. 2.

The tanks supported on the 4th floor are now to be considered. There were 14 of them, in two rows of seven each, their arrangement with reference to the columns being shown in Fig. 4. It will be observed that each tank is not placed centrally on the floor space between four columns, but is much nearer to one column than to either of the others, and the nearest adjoining tank is also in proximity to this one column. This column, therefore, receives more than its share of the load.

The tanks are each approximately 12 ft. 6 ins. × 13 ft. 6 ins. in area by 15 ft. deep. Filled full of water they would contain about 158,000 lbs. of water. The weight of each tank itself, being built of ¼-in. iron, including laps, rivets and braces, is nearly 10,000 lbs., and the weight of the section of the floor which supports it is also nearly 10,000 lbs. Assuming that the tank is not quite full, we may take 170,000 lbs. as the approximate weight of the full tank and floor section supported by the cast-iron columns. Fourteen such tanks would hold 14 × 158,000 = 2,212,000 lbs., or 1,000 tons, or 265,000 gallons of water.

The nearest side of the tank is not over 6 ins. distant from the brick wall, and it is about the same distance from the line joining the centers of the two opposite columns to which it is nearest, as shown in Fig. 4. The center of weight of the tank is, therefore, 6 ft. 9 ins. from the brick wall and 7 ft. 3 ins. from the center line of the nearest 24-in. I-beam. The I-beams being 19 ft. apart, the nearest I-beam receives from one tank and

$$\text{its supporting floor } \frac{19 - 7\frac{1}{4}}{19} \times 170{,}000 = 105{,}130$$

lbs. and from the adjoining tank on the other side an equal amount, making 210,260 lbs., which is carried by the 24-in. I-beam which is between two of the closely adjacent tanks. Two such beams were in that portion of the floor which fell, as shown at A and B, Fig. 5. Of the weight of 210,260 lbs. on this 24-in. beam, there is carried at the end to which the tank is nearest

$$\frac{16 \text{ ft. } 7 \text{ ins.} - 6 \text{ ft. } 9 \text{ ins.}}{16 \text{ ft. } 7 \text{ ins.}} \times 210{,}260 = 124{,}680 \text{ lbs.}$$

This is the load which is carried on a single cast-iron lug of a 7-in. square cast-iron column 10 ft. 6 ins. long, which rests on a similar 7-in. column, which in turn rests on an 8-in. square column of the same length, and that in turn on a 9-in. square column 12 ft. 6 ins. long. As shown in Fig. 3 there is a clearance of about an inch between the end of the beam and the face of the column, so that the load is applied eccentrically at a point at least 1 in. from the face of the column.

The cross section of the lug, including its diagonal bracket, at its point of junction with the column is about 21 sq. ins. If the lug is in direct shear at this point of junction the shearing stress is nearly 6,000 lbs. per sq. in. Whether this is a safe stress may well be doubted. The text books are practically silent on the subject of shearing strength of cast-iron, and we know of no experiments which show what is the actual resistance of a lug of the shape and size of those used in these 7-in. columns. To entrust the safety of a whole building to a single cast-iron lug of this small section sustaining a load of 124,000 lbs. appears to be a risk which no structural engineer in his senses would ever undertake.

We have assumed above that the lug is liable to break by direct shear at its point of junction with the face of the column, where its cross section is the maximum, but there is no certainty that it would so break. The 24-in. I-beam clears the face of the column by 1 in., and there is no certainty that it has a fair bearing upon the flat upper surface of the lug. The actual bearing may be upon any portion of the flat surface, even at its extreme end, 4 ins. from the column. In that case the lug may break by transverse stress, its upper portion being in tension and its lower portion, that is the diagonal bracket, in compression.

The strength of the lug will then depend upon the tensile strength of the upper portion, which strength is a matter of the greatest uncertainty. How uncertain it is is indicated by the appearance of the fracture of the junction of a lug with one of the 9-in. square columns on the first floor which is now to be seen, somewhat rusted, in the debris. The appearance of this fracture is shown in Fig. 6, the dark-shaded portion indicating metal of very open grain, like No. 1 X pig-iron, while the lighter portion is the ordinary fracture of good close-grained foundry castings. It is evident that the open grain is due to slow cooling of that portion where there is the greatest bulk of metal. The lug being from 1½ to 1¾ ins. thick, and the corners being further thickened by fillets, while the column itself is presumably not over ¾-in. thick, the rate of cooling at the point indicated by the shading in the sketch must have been much slower than that of the remainder of the column. Shrinkage strains, in addition to opening of the grain, must have been induced during the cooling at this point, with the result that this portion of

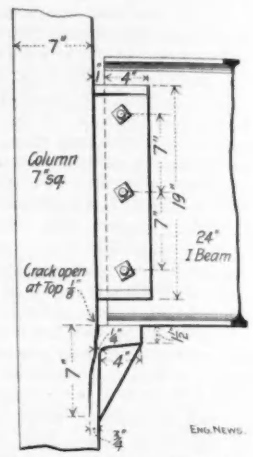


Fig. 3.—Cast Iron Column with Fractured Lug.

the metal latest cooled would in all probability have its tensile strength reduced greatly below the normal or average strength of the iron.

A further indication of the impossibility of calculating how great a load such a lug will resist, or of predicting how it will break, is shown by the actual fracture of a lug on one of the columns which is still in place on the 3d floor, and which originally supported one of the 24-in. beams. The location of this column is shown at C, in Fig. 5. The appearance of the fractured lug is shown in Fig. 3. The crack starts at the corner of the flat top of the lug and the vertical face of the column, runs first downwards and backwards into the column, and then vertically downwards ¾-in. from the face, the crack apparently going through the corner of the hollow square section of the column. The crack has practically the same appearance on the opposite side of the column. After the lug had thus cracked, letting down the beam say 1-32-in., it appears that the strength of the three ¾-in. bolts came into play by the clearance space in the holes in the side lug being taken up, so that the fracture of the supporting lug never was completed, and it remains as shown in the sketch. That a cast-iron lug would break in this manner would probably never be thought of by any de-

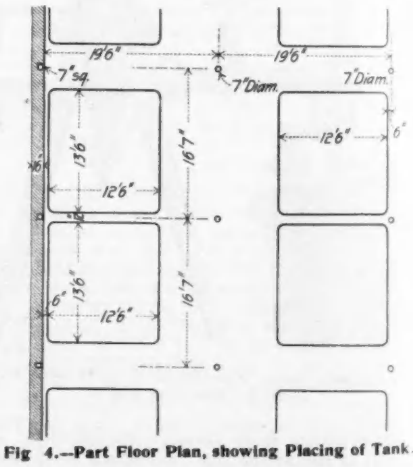


Fig 4.—Part Floor Plan, showing Placing of Tank.

signer of cast-iron columns such as the one here described, and if thought of there is no formula by which its resistance to such fracture could be calculated.

From what has been shown above it is plain that if there were no other possible cause of the disaster to the building, if the tanks did not push out the side wall and pull the 24-in. beams from their fastenings to the second row of columns, if the

cast-iron columns themselves were of abundant strength, and safely fastened and braced, which they were not, the cast-iron lug, subjected to a possible load from two nearly full tanks of 124,000 lbs. is such a dangerous feature that it may justly be suspected of being the actual element of the construction which led to the disaster.

But there are other features of the construction which are even worse than the cast-iron lug, and

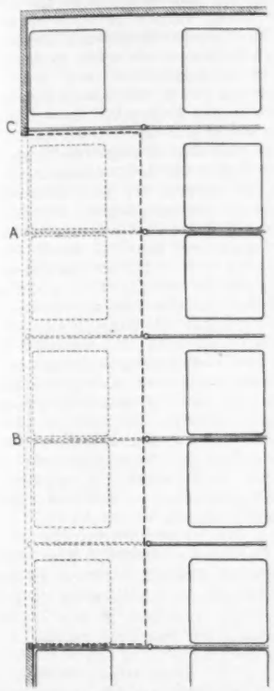


Fig. 5.—Diagram showing Position of 14 Tanks. (Part which fell shown in dotted lines.)

are therefore more likely to have been the cause of the failure of the building. The first is the extremely eccentric loading of the square cast-iron columns. If we suppose that the building up to the level of the third floor was amply strong to resist every possible strain, which it was not, that the 7-in. column on the third floor, which supported the 24-in. I-beam was properly bolted and secured at its base, which it was not, then the single feature of placing a load of 124,000 lbs., not centrally upon the 7-in. sq. cast-iron column, but so eccentrically that it was applied at a point anywhere from 1 to 4 ins. outside of the face of the column, is an element of danger the extent of which it is impossible to foresee, and to which the application of a formula is little better than guesswork. The eccentric loading of the exterior row of columns on the 3d floor is, therefore, one of the several possible causes of the accident.

The outer row of columns on the other floors were also loaded eccentrically, but as their loads were light they were probably not dangerously loaded by the loads of their particular floors.

We next have to consider the stress brought by the combined load of the 2d, 3d and 4th floors upon the combined column composed of the 9-in. column on the 1st floor, the 8-in. on the 2d and the 7-in. on the 3d. If this was one solid continuous column 33 ft. 6 ins. high, it might have a certain degree of stability, requiring to be stayed at the levels of the 2d and 3d floors to give it additional strength. But it is not a continuous column, but a series of detached columns, joined together in the crudest manner by four ¾-in. bolts, as shown in Fig. 2. The eccentric load applied near the top of the 7-in. column brings a bending action on the combined column, which is resisted practically not at all by the fastening at the base of each of the separate columns, but only by the imperfect fastening of three ¾-in. bolts in the end of each of the transverse floor girders, which fasten them to the side lugs on the columns. The bolts are driven loosely into the holes, and only one out of the three may have an actual bearing and be in position to resist the initial movement of the beam. The whole combined column tends to bend under the load, and the bending is insufficiently resisted by the column and beam fastenings.

The whole building is absolutely devoid of any diagonal bracing which would resist any change of shape due to bending of the combined columns, to settling of the foundation or to wind stresses. The character of the design may be judged by comparing it with a water tower of the same shape and size, designed to carry a load of 1,000 tons or 265,000 gallons of water, with the tanks supported by 7-in. square cast-iron columns, loosely bolted to 8-in. columns below them, with a load of 124,000 lbs. carried by a single lug cast on one of these columns, and without a single diagonal brace in the whole structure. There are hundreds of elevated water tanks, supported on towers, to be found in connection with the water-works systems of this country; but we venture to assert that not one case can be found where such a tower has been put up with such entire disregard of the necessity of bracing as was shown in this case.

What is believed by many to be the cause of the accident is the bulging of the tanks pushing outwards the brick wall near which they were placed. The wall was so insecurely fastened to the skeleton, its only connection being a bent strap of 2×¼-in. iron held by a single ¾-in. bolt at each joint of the columns, that it would seem that these fastenings should have been torn away by the falling of the wall if it was actually pushed over, allowing the skeleton to stand. Whether the bulging of the tanks was the cause or not, it is evident that they were so constructed as to be liable to such bulging, and their being placed within 6 ins. of the wall was well calculated to let them push out the wall. The shape of the tanks is shown in Fig 7. Three of the corners had five braces each spaced 3 ft. apart, and the fourth had six braces 2 ft. apart. The braces were of 2×½-in. iron, and were fastened to the tank at each end by a single ¾-in. rivet. In many cases the riveting was poorly done, the riveted head being flattened down too much, possibly on account of the rivets being a trifle too short for the thickness of metal, so that the head had less strength than the body of the rivet. From the position of the braces it appears that the maximum stress upon any one brace would be on the one marked 2 in the sketch. The pressure per sq. in. of water at that point would be 4.55 lbs. per sq. in., or 655 lbs. per sq. ft. Two similar braces opposite each other on a side 13 ft. 6 ins. long would sustain the pressure from an area of 40.5 sq. ft., the total load on which is 26,527 lbs. This load would be so divided between the two braces and the ends

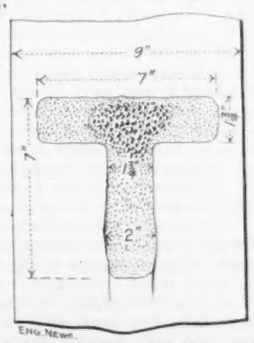


Fig. 6.—Appearance of Face of 9-in. Column after Breaking off the Lug.

that each brace would sustain one-third, or 8,842 lbs. But the brace is at an angle of practically 45°, and the stress on it would be 8,842 × 1,414 = 12,500 lbs. The brace itself would have a tensile strength of about 50,000 lbs., but the rivet, being only ¾-in. in diameter, or 0.44 sq. in. area, would have a tensile strength of only about 22,000 lbs. and a shearing strength of about 17,600 lbs. The rivet is subjected partly to tension, partly to shearing, but also to a strain tending to tear off the head, which the head, if hammered down too thin, resists only in detail and not all at once. It is evident that the heads of the rivets were insufficient to stand the strain upon them when the tank was full of water, for in one of the tanks 13 of the braces were pulled off, and twelve in another. The bulging of the tanks, of course, would follow the giving way of the braces. If the proximate cause of the failure of the building was really the bulging of the tanks, the bulging was caused in the first place by bad design, and in the second by defective riveting. The defecting riveting was very likely due to the rivets having been ordered ¼-in. too short. One single

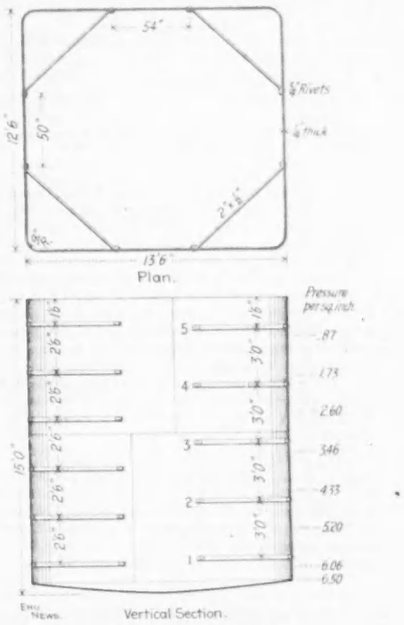


Fig. 7.—Details of Tank.

imperfect rivet head failing and the brace becoming thereby unfastened, the pressure upon the adjoining braces and rivets would be suddenly increased, breaking them also, and allowing the tank to bulge.

There is still another possible cause of the failure of the building against which no provision seems to have been made. A very slight settling of the wall, due to the shrinkage of the mortar, would bring a strain upon the 2×¼-in. clips which fastened the wall to the cast-iron columns. The skeleton of the building should have been sufficiently stable to allow these clips to be pulled out or broken without endangering it, but when the columns were already subjected to eccentric loads and bending strains the additional strain produced by a pull of the wall upon the clips may have been the last additional element needed to pull down the columns.

We do not care to try to fix the responsibility upon any one of the many parties concerned with the failure of this building. Whether it was due to the negligence of the owner, of the architect, of any one of several contractors, of the inspectors or other officers of the Building Department, or to the imperfections of the law which allows such buildings to be erected, may be left to judicial investigation. What we are now concerned with is to call the attention of engineers and architects to the danger of erecting buildings of this class without having a thoroughly competent structural engineer pass upon every detail of the iron and steel construction. Since the failure of the Ashtabula bridge 20 years ago no bridge engineer has dared to risk the safety of a bridge upon the lug of a cast-iron column. Will it require a disaster of similar extent to awaken engineers and architects to their fatuity in continuing the use of such cast-iron columns with all their hidden defects and their eccentrically-loaded lugs in buildings, the failure of which may cause the loss of hundreds of lives, and to their recklessness in piling up story after story of columns of both cast-iron and steel without making any pretense of supplying diagonal bracing to compel the different members of the structure to act together?

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The sundry civil appropriation bill which has recently been approved by the President, carries appropriations of $150,000 for surveys of the Nicaragua Canal, and the same amount for surveys of canal routes from the Great Lakes to the Atlantic seaboard. In each case a commission of three engineers is to have charge of the work. The Nicaragua Canal Commission is to consist of one member of the Corps of Engineers, U. S. A., one member from the Navy, and one engineer selected from civil life. For the Lakes and Atlantic canal the commission is to consist of one civilian engineer and the other two members may be appointed from the Corps of Engineers and from the Coast Survey. The appointment in each case is to be made by the President, and it is reported that the selection of the members of each of these commissions will be made very soon. It is to be earnestly hoped, in view of the magnitude of the questions which are involved in each case, that the President will select to fill these positions engineers of the very highest rank of professional ability.

The responsibility which will be entrusted to these commissions is enormous. They are to advise the nation respecting the merits and demerits of engineering enterprises whose cost reaches hundreds of millions. They must weigh judicially questions involving the most complex engineering problems; and to reach correct conclusions a high class of expert knowledge and the ability to judicially weigh and decide all matters without the least prejudice or bias are manifestly necessary. The final conclusions which these commissions may reach will not stand by reason of the reputations of their members alone, no matter how distinguished these men may be, unless these conclusions are so fortified by observed facts and figures and by sound and logical reasoning that they will carry conviction to the minds of intelligent men. In view of these self-evident facts, it is to be earnestly hoped that the President may appreciate the responsibility which will accompany these appointments and will make his selections solely with respect to the professional ability and standing of the candidates. The interests of the country should be paramount to any and all considerations of political or personal influence, or the claims of any whose names may be urged for these positions on other grounds than their conspicuous fitness to fill them.

The very beautiful pictures of European bridges which we present to our readers on our inset sheet this week will be examined, we are sure, with no small degree of interest by American bridge designers. Everybody knows in a general way that there is a wide difference between European and American bridges with respect to their artistic design. Until the last decade, with a few notable exceptions, what may be called the architecture of bridge designing has been almost entirely neglected in this country. One main reason for this has been, of course, the fact that the heavy expenditures which American city and railway corporations have had to incur in bridge construction has made them unable to afford the necessary expenditure to make these structures beautiful. These conditions, however, are rapidly changing; and at the present time when cities are spending great sums of money for parks and pleasure grounds, and for the lavish decoration of public buildings, there can be no doubt that public sentiment in many cities is strongly in favor of making any new bridges which may be constructed monuments of good architecture as well as examples of good engineering.

How to meet this popular demand is a question which many engineers must face, and unless they are themselves architects as well as engineers they will do well to call to their aid some member of the architectural profession. A study of the European bridges which are shown upon our inset sheet will show that it is the architect's work, chiefly, and not the engineer's, that has made these structures so beautiful. It will be seen that the graceful lines of the suspension bridge and the arch are as markedly superior to the straight truss and the girder, from the artistic point of view, on the other side of the water as they are here; but the architect has been able by the creation of noble portals, beautiful towers and graceful piers, to convert even the truss and the girder into structures of architectural beauty.

In the interest of the extension of the foreign trade of this country, the president of the National Association of Manufacturers of the United States has addressed a very pertinent letter to President McKinley presenting for his consideration some suggestions touching the appointments to the consular service. It is pointed out that no other agency is now so potent as this in the encouragement and development of our trade with foreign nations, even in the present condition of the service. But certain reforms and improvements in this branch of the government service, reforms which are now recognized as needful and proper, would increase its material value beyond measure. The two great evils from which the service has suffered are, first, the appointment of men who are lacking in the needful qualifications and receive office simply as a reward for political service to the party in power, and second, the unnecessary removal of men whose experience in office has made them competent to efficiently discharge their duties. Unfortunately, it is not in the minor positions that these evils are most frequently encountered; the real injury to American commerce comes from the changes made in the chief consular centers, where the largest interests are involved. The frequent changes at these important points, due to the greater pecuniary returns to the incumbent, are more damaging even than the appointment of men originally unqualified; for in many cases such men have profited by the years of experience and fill the position with credit to the country and great benefit to our foreign trade. To remove such men means the entire loss of this accumulated experience and training, and the further loss of the time necessary to qualify a successor. The practice of other countries is directly the opposite. Proven fitness for office and active work in the development of trade is rewarded by long continuance in office, promotion in the service to more important positions and a final pension at the end of official life.

To remedy the evils of our own service the Association expresses the wishes of the thousand manufacturers included in its list of members, and the wish of everyone who seeks the development of American foreign trade, by suggesting the following general rules of appointment: Let the changes in the consular service be as few as possible; removals should only be made for demonstrated incapacity; fill vacancies as much as possible by promotions or transfers; base appointments solely upon proper qualifications for the position without regard to political service, and, finally, see that American citizens are alone appointed to any consular office. These suggestions are so evidently proper and businesslike, when the interests of American commerce are alone considered, that it is difficult to understand why other methods should prevail at all. The comparatively slight interest which has been taken in past years in the development of our export trade may in part explain the fact that consular positions were long regarded only in the light of perquisites to be distributed as rewards for political services. But conditions are changing rapidly, and have changed to a marked degree. The manufacturers of the United States were never so deeply concerned in the extension of their foreign trade as at the present time, and the markets of the world were never so widely open to American commercial enterprise. For these reasons the suggestions quoted are of the utmost importance; and though it will be difficult to turn some master politicians from the evil ways of their predecessors in power, the removal of competent men, of whatever political party, would be peculiarly unfortunate at this time. It is to be fervently hoped, therefore, that common business wisdom and the real interests of the country will have more weight than party politics and the urgent petitions of party workers in the filling of consular positions.

STREET PAVING AN IMPROPER BASIS OF COMPENSATION FOR STREET RAILWAY FRANCHISES.

The most common provision for compensation in street railway franchises in this country, where any compensation has been named, is that the company shall do more or less work in connection with pavement in the streets through which its tracks are laid. The amount of paving which the company is to do varies from paving between the rails to paving, repairing and renewing the total width of the street. Generally the agreement covers only the portion of the pavement between and for a foot or two outside of the tracks, the work being limited to repairing this portion of the pavement or putting down new paving, when the road is first built, either with or without keeping it in repair.

It is, of course, true that paving work by street railway companies has not been done solely as compensation for the franchise. In the days of horse-cars, the company frequently preferred to do the paving between the rails so that it could choose a pavement that would give the best foothold for its horses. As a matter of equity it was proper that it should pave, since the chief wear on the paving between the rails was due to its own traffic. Again, the wear on the paving for a width of a foot or so outside the rails is very much greater than on the rest of the street. In requiring the company to keep this paving also in repair it was considered that the company was to some extent obligated to do this to make good the damage caused by the presence of its rails in the street service.

Another manifest reason for placing the responsibility of the paving upon the street railway company was that in this way the company was enabled to remove the paving when necessary to repair its tracks and to replace it without question arising of the city suffering damage by injury to the pavement.

The conditions of street railway operation, however, have been wholly revolutionized in the past decade. The street-car horse is destined soon to become as extinct as the Mastodon. The small round cobble paving between the rails over which he hobbled has fulfilled its field of usefulness. There is no longer any reason for making the paving between the tracks different from that which covers the rest of the street. Improved rails have greatly reduced the wear on the pavement adjacent to the rails. Improved track foundations have lessened the need to remove the pavement for track repairs.

In view of these facts it would be well worth while to investigate the experience of cities which have adopted this plan for obtaining a return from street car franchises, and to ascertain what are the merits or demerits of the plan, under the conditions which exist to-day. But to hunt up the records of experience of many different cities in this field would be a task very difficult to accomplish. Instead of this we turn to the experience of a single city, Philadelphia, and this we are enabled to do by the recent publication of a valuable little monograph, "The Street Railway System of Philadelphia," by Mr. Frederick W. Speirs, which is reviewed in another column.

Philadelphia is an extreme case, both because of the amount of paving work required of its street railway companies by their franchises, and because these requirements have been upheld by the highest courts after long litigation, and the companies have expended millions of dollars on street paving work in consequence.

There are now but two companies operating street railways in Philadelphia, all but one of the many companies which built lines during the past 40 years now being controlled by the Union Traction Co. Most of the original companies bound themselves to pave, repair and repave the streets to their full width for the full length of their tracks, as the city might order. These provisions were complied with in varying degrees for many years, depending largely upon the activity or lethargy of the city officials and the public, on the one hand, and the attitude of the companies from time to time. The conditions requiring street paving to be done were re-enacted in the ordinances allowing change to electric power, and from 1892 to 1896 the Chief of the Bureau of Highways estimates that 271 miles of streets were repaved by the companies at a cost of about $9,000,000. But this work, as well as previous repairs and new paving, was not done without the most strenuous resistance on the part of the companies. The city, however, was uniformly sustained by the courts.

The history of street paving and repairing, Mr. Speirs states, has been one of endless annoyances, "with alternate neglect and partial performance of obligations" by the companies. It is affirmed that the large amount of new paving recently done by the companies has not been carried out in accordance with the specifications. This last is not to be wondered at, since on this and street work done by other companies holding city franchises the Bureau of Highways of the city has accepted the assistance of inspectors paid by the companies.

The conclusions expressed by Mr. Speirs, after reviewing the paving operations of the street railways of Philadelphia, are well worth quoting in full, as follows:

> The plain lesson derived from the foregoing sketch is that the imposition of an obligation upon street railway companies to pave and keep in repair the streets they traverse, is a most unwise and vexatious method of exacting a return for privileges granted. This fact is not apparent to Philadelphians at the present moment, for they are in the first flush of enjoyment of admirably paved streets. Almost the entire length of roadway traversed by the lines of the street car companies has been repaved within the past four years. The rapid transition from cobble stones to asphalt and Belgian block, which has transformed Philadelphia from one of the worst to one of the best paved cities in the United States, has induced a feeling of complacency that makes it easy to forget past sins of omission. But when the new pavements, which were the specific price of trolley privileges, begin to need extensive repairs and renewals, the old difficulties seem likely to reappear. The railway companies have no business interest in the maintenance of good pavements. Indeed, their business interests are distinctly opposed to them. The general use of the bicycle, a formidable rival of the street cars in local transportation, is made practicable by smooth, well-kept pavements. In all large cities the bicycle has made serious inroads on the receipts of street railway companies, but in Philadelphia insult has been added to injury, since the irony of fate has compelled the companies to make smooth the highways of their adversaries. The induction from wide experience of corporate action in such matters, as well as the history we have just reviewed, seems to indicate that as the present pavement wears out the companies may be slow to recognize the need for repair and renewal.
>
> The experience of Philadelphia emphasizes the generally recognized fact that a city should never entrust the care of its highways to any agent other than a municipal official or commission, so chosen as to be immediately and effectively influenced by public opinion. So long as public opinion, demanding well-kept streets, can only operate through a municipal officer who must be urged to the difficult task of moving a great corporation, often reluctant to act, and with large opportunities for delaying and even evading the discharge of duty, it will not be surprising if the streets are badly neglected.

The above quotation presents most forcibly some of the objections to street paving as a compensation for street railway franchises. The statement that "street railway companies have no business interest in the maintenance of good pavements" is doubly true now that horses have been replaced by electricity.

It is interesting to note that away back in 1855, when street railways were first being seriously discussed in Philadelphia, Mr. Strickland Kneass, then Chief Engineer of the city, made a report on the subject in which he recommended that the city should build the various lines of roads as needed and lease them to companies for operation, urging as one of his reasons, that:

> The city will then know where to look for the proper repair of its highways, and not be, in a measure, dependent upon a company of individuals whose only interest will be the amount of dividends realized.

Forty-one years later, Mr. Thos. L. Hicks, Chief of the Bureau of Highways of Philadelphia, urged in his report for the year 1896 that the city should resume the responsibility of the care of all its streets, arranging with the Traction Co. for a percentage of its gross receipts for release from the paving obligation.

Such expressions as these from city officials before the inauguration of the street railway system and after 40 years of experience with pavements maintained by companies, together with the conclusions drawn by Mr. Speirs, after a careful study of this and other matters pertaining to the history of street railways of Philadelphia, are very strong evidence, it appears to us, that paving is not a proper basis of compensation for street railway franchises. If Philadelphia, under a franchise so favorable to it in this particular and so clearly drawn that the courts uphold it in the strongest terms, has not had a satisfactory experience, what can be expected in other cities, which have granted franchises calling in less explicit terms for a far less amount of street work in return for privileges granted?

We can see no reason to believe that on the average, and in the long run, cities which aim to secure revenue from the street railways by having them pave the streets, will have any more satisfactory experience than Philadelphia.

Let us review some of the reasons why street paving should not be done by the company. First and foremost is the difficulty of compelling the company to perform the obligations it undertakes. The law has processes to compel the payment of a debt, and to punish the commission of a crime; but it is well-nigh powerless when it comes to compelling a man or a corporation to perform a certain task and to perform it conscientiously and well, unless he does it as a contractor does work, under strict specifications and supervision.

Perhaps a company can be compelled to newly pave the streets which it agreed to pave. How shall it be compelled to do this paving with good material in a thorough and workmanlike manner? Perhaps, after long delay, it can be compelled to undertake the work of repair after streets have become so dilapidated as to be a public injury and nuisance; but how can it be compelled to keep the streets continually in good condition?

If the compensation for a franchise is a percentage of the gross receipts, it is a simple matter for a city's financial officers to determine and collect it. But if the compensation for a franchise is the keeping in repair of paving, it is all the time a matter for expert opinion what the company's real obligations are. It is almost inevitable that this should give rise to conflict between the officials of city and company when both are conscientiously doing their duty. When either are neglectful of the interests they are called on to protect, either the stockholders of the company or the taxpayers of the city corporation must suffer.

Again, this basis of franchise compensation is defective in that it does not secure to the city all it should receive. It heavily burdens the company with the cost of new paving at the outset, when it must borrow money to pay its bills. It leaves light payments for the later years and makes no provision for increase of revenue to the city as the earning power of the franchise increases, but rather the reverse.

From the company's standpoint, therefore, it is an undesirable mode of compensation. The amount which it will cost the company is always uncertain. The company is obliged to undertake a class of work wholly outside of its business, and which could be better and more economically done by the city's own department. Again, the agitation of the company's paving obligations often arouses public animosity toward the company. This has its influence in alienating public sympathy in times of strikes; it even has its effect upon traffic.

The full side of the case against street paving compensation cannot be presented however, without a statement of the correct method of securing revenue from all public franchises, that based on the gross receipts. The basal fact at the root of franchise compensation, is that the highways belong to the community at large. If a person or corporation wishes to monopolize part of the surface or the space over or beneath them to supply some public necessity, like heat, light or transportation, he is entitled, we will all agree, to a fair return on the capital he invests if he can earn it; and this return should be large enough to compensate for the risk of loss which he undergoes, and to pay a sufficient profit to induce him to undertake such enterprises. But all return above this is, strictly speaking, the rental value of the franchise. If a street railway pays an income of 40 or 50% on its cost, it is not because of the industry or skill of its owner. It is because, and solely because, of its location, and the people who live in the great city around it are the ones who make it so profitable, and to them or to their representative, the city corporation, this rental value rightly belongs.

It is manifest, of course, that the ideal equity thus laid down, can only approximately be carried out in making a franchise contract; but the fairest way yet devised of effecting this is the method of basing the franchise return upon the gross receipts.

Experience amply proves that a return for franchise privileges on any other basis than gross receipts is bound to be disappointing to the city. The very idea of payment for a franchise involves the principle that the compensation should be commensurate with the profitableness of the enterprise, and this can be measured only by the receipts.

We are beginning to hear something in these days, however, of those who declare that a tax on the street railway's gross receipts is a tax on the passenger. If a company can afford to make heavy franchise payments into the city treasury, they say, it can afford to reduce rates of fare. It is not to be denied that there is something in this claim. It is indeed absurd that a street railway company in a great city with an enormous traffic should charge the same rate of fare as a railway in a struggling village. On the other hand, it is manifestly impossible that the rate of fare can be varied to suit all changes in condition of a city or a street railway company. The proper course in granting a franchise would seem to be to fix the rates of fare at a figure which will certainly be sufficient to pay the company's operating expenses, a reasonable interest on the money invested and some small return to the city in the shape of a percentage on the gross receipts. If the road does better than this, let the percentage of the gross receipts rise in a greater ratio, so that while all share in the benefit, the city will receive a larger proportion. Finally, at the end of a certain term of years, if the road proves exceedingly profitable to its owners, let the rate of fare be lowered, so that those who patronize it may share in the benefits.

This is a system of handling the street railway franchise matter which is equitable to all parties, and in it we find no room for placing the responsibility for the street paving upon the street railway company.

LETTERS TO THE EDITOR.

Errors Charged to the Contract System in Surveying Public Lands.

Sir: I see in your issue of March 4 some comments on "The Contract System of Surveying." That is probably about the only way to have it done; but it is open to very serious objections, and its faults are greatly aggravated by careless inspection of work before acceptance.

To illustrate: I will cite the case of a serious error in the line between Section 4 T 20 N. R. 3 W 3d P. M. and Section 33 T 21 N. R. 3 W. 3d P. M. The error was caused by a mistake of just "one out" with a two-pole chain, i. e. 20 rods, or five chains. It will be more readily seen by reference to the following diagram showing the

government notes as returned by the Deputy Surveyor. The error is so palpable that any one, at all conversant with the public surveys, could detect the error on inspection. The error is on a "standard correction line," and thus vitiates a whole tier of Townships lying between two standard correction lines. The diagram and government notes are as follows: Scale 64 c. per in. It is obvious on its face, that the error was one of count from Q to q i. e. from s. e. cor. Sec. 33 to s. w. cor. of s. e. ¼ of Sec. 33. It is recorded as 40 chains, but is in fact only 35 chains. This error caused all of the corners R r, S s and T to be made just 5 chains east of the point intended, which is further evidenced by the fact that the south line of the west half of Sections 31, 21 and 3 is recorded as 40.00 chains while the north line is only 34.46 chains.

How this notorious error could have escaped the observation of the two Deputy Surveyors following the one who made the first error in his measurement of the standard correction line, and all the errors finally escaped the scrutiny of the Land Office officials remains to be revealed by the unwritten and secret history of this survey. Besides the errors incidental to imperfect instruments and observation, we find the field full of minor errors, such as errors of bearing trees; in either course or distance, and the length of jogs. The latter occur frequently in the timber where the evidence of witness trees yet remain, and it is quite possible, not to say very probable, that such errors are also to be found in the prairie, though not so easily proved. There are several of this kind gravely suspected in this country since the recorded jogs can not be made to harmonize reasonably with the facts developed by actual survey in the field. All of these little (and great) discrepancies tend to make trouble for the land surveyor and the land owner as well.

Yours very truly, D. L. Braucher.

Lincoln, Ill., May 24, 1897.

An Engineer's Jottings.

Sir: A very popular route out of St. Louis, for the east, is the Baltimore & Ohio Southwestern, Royal Blue Line. The road to Cincinnati has been wonderfully improved by careful engineering, and new bridges at many points, as well as the appearance of structures and track, give evidence of the permanance with which the line is being reconstructed.

Cincinnati presents many evidences of material improvement, but the most striking features in an engineering way are the renewals of the bridges across the Ohio.

The Southern Railway bridge has new spans of modern design for all the short spans on the Ohio side of the river. The Pennsylvania R. R. bridge, which has been in process of reconstruction for some time, is practically completed, and while it is not a thing of beauty it is manifestly one of strength.

The sidewalks, roadway and electric car tracks, approach the river spans on different line and grade from the railway track and presented a very difficult problem for solution. A part of the approach is formed of brick arches on a curved alinement. While a different arrangement of the grade on the sidewalk of the river spans would no doubt have been difficult, the grade line is now much broken by the conformity to the floor camber of the channel span.

This span, with four trusses, has the two center ones spaced just far enough apart to allow room for the electric car track.

The structure is heavily detailed, the chords being laced with angles. The new piers were built between the old ones and the old masonry is now being removed to flat boats in the river and towed away.

Just rounding into a wharf below the bridge was the "Bostona," one of the splendid fleet of boats to which belongs the "Fleetwood," "Telegraph" and "Big Sandy." These sidewheel steamers are among the finest afloat on any inland water and are a reminder that the U. S. Engineer Corps is now engaged in the thorough improvement of the Ohio River. The contracts have recently been let for the movable dam below Beaver, and the first one below the famous Davis Island dam.

This dam is of the French or Chanoine type and is similar to the Kanawha dams described in Engineering News of Dec. 31, 1896, except that the trestle and bridge for manoeuvring the wickets is not to be used, but they will be operated from a boat.

The work of reconstructing the Roebling suspension bridge is progressing rapidly. The new cables are laid up and the interesting work of wrapping them is in progress. Some six gangs are at work at different points, on swinging scaffolds.

The wrapping machines are of the same type as were used on the Brooklyn bridge, the separate coils of wire being spliced together, so that the wrapping is practically continuous. The process of splicing is an interesting detail; the two ends are filed to lay together in a long scarf, and are then wrapped with a fine brass wire and around this is wrapped a small piece of sheet copper. The flux is then sprinkled on and the joint held in a portable forge, until the copper melts and accomplishes the brazing. After filing smooth, the joint is complete, all within a very short time.

The new cable has not been cradled and hangs in a vertical plane, above and outside the old one, so that footways have been constructed on the old cables for the workmen.

The suspenders have been shortened up and provided with long U-shaped screws, to draw up the new floor system to the new grade when the new beams and stringers have been placed.

The new anchorages are being constructed with open vaults around the strands of the cable, where they connect to the anchor pins, so that they will be easily accessible for examination and will not cause trouble, as was the case with the old anchorages on account of the old cables being built in solidly.

From Cincinnati to Columbus, over the Midland Division of the B. & O. R. R., shows great improvements and upwards of a dozen spans of steel are seen in place of the old wooden bridges and trestles which had outlived their usefulness. These are all built up to the standard of the main line.

At Columbus a much needed improvement is nearing completion in the shape of the remodeled Union Station. The great dark train shed, which has been such a landmark, has had the brick end walls removed and trussing put in to carry a large area of glazing, thus making much better lighting. The end next to High Street is being extended several trusses as well. Along the depot side of the new viaduct has been constructed a row of storerooms and nearly in front of the train shed is the new entrance to the Union Station. The construction is of terra cotta, but gives promise of being a very pleasing bit of architecture, with its Corinthian columns and well proportioned detail.

From here the approach, both for foot passengers and vehicles is along an elevated way to the offices, waiting rooms and train shed. These are built on the south side of the train shed and just south of the old station rooms. By means of a clearstory, much additional light will be given for the train shed. Columbus is certainly to be congratulated on this long waited for improvement.

May 29, 1897. E. G. C.

Pioneers of Centrifugal Pump Dredging.

Sir: Several persons, notably two in California, have endeavored, during the past ten years, to establish their claims to the invention of the art of hydraulic suction dredging. The courts have been persistently invoked to establish and rivet a patent monopoly under patents granted by the government thirty years after every broad combination claim had been successfully, scientifically and profitably demonstrated by the real inventors. A recent decision of the Appellate Court in San Francisco has been heralded by its beneficiary as a convincing warrant for the inventor's laurel. It is not necessary to detract from anyone's measure of actual accomplishment, but, in view of the public interest, it is right that all should know the historical truth, which neither courts nor persistent misinformation to the press can alter. When examined in the true light, it will be found that this case was fought between two parties, who were patentees, each trying to establish his own patents and carefully excluding what was done in foreign countries long prior to their so-called inventions. The facts are, that neither Bowers nor Von Schmidt is entitled in any sense whatever to more than trifling and unimportant claims on two or three specific forms and mechanical variations. These, in turn, involved nothing more than the utilization of improved forms of pumps, engines and mechanism evolved in other arts by other men. There is room to-day for great improvements in suction dredging machine design, but the field is open to the use of the broad principles of the art. When the people and the courts know the truth, they can be safely left to rate the pretensions of those who claim honor and tribute for the work of the real pioneers, of whom two only now survive.

While the philosopher Papin invented the centrifugal pump and air-blower, it remained to other men to put it into practical use. The ideas of the American Andrews were taken to England, and at the London Exposition of 1851 began the rivalry of Gwynne, Appold and other makers. The centrifugal pump then made its way slowly in England and its use extended increasingly to the continent of Europe. Louis Schwartzkopff, of Berlin, the proprietor even at that day of its leading machine works, visited England, and on his return designed and introduced the centrifugal pump into Prussia, calling it a "Kreisel," or whirlpool, pump, by which name it is still known in Germany. His scientific observations of performances and attainments, promulgated to gain the favor of engineers, are still standard in the mechanical reference books of Germany. German engineers of that day, and until now, have characteristically written much to prove this or that theory to account for and express mathematically the action of these pumps. The absence of valves and the consequent facility with which solids could be raised with the water and discharged from these pumps were among the advantages urged by all makers from the earliest. It remained for the occasion to arise to suggest the application of the centrifugal pump to dredging purposes and the designing of the mechanism to produce the most effective results. Development followed its use by practical men.

There are two natural divisions to the dredging art: First, that of discharging the spoil into barges or into a hopper contained in the dredge hull; second, the discharge onto adjacent land or into water through a pipe line of greater or less length. The last United States River and Harbor Act which was passed before the Civil War, practically compelled the first application of the centrifugal pump to dredging, under the first division, as above set forth. In 1855, Osgood, of Albany, N. Y., was obliged to throw up his undertaking to remove a bar in the approaches of Charleston, S. C., because his apparatus would not work in a sea-way. In the latter part of that year, Captain (afterwards General) Cullom, the U. S. Engineer officer in charge, reported to the War Department that he had just examined an invention by Nathaniel H. Lebby, which was most promising, and which, he thought, would solve the problem. In Capt. Cullom's report of 1856 will be found a full description of the first suction dredger invented, built and operated for bar removal in a sea-way. It was called the "General Moultrie," a single screw boat, 150 ft. long, and it was provided with internal hoppers. The centrifugal pump was 6 ft. in diameter, and the suction, at first of iron rings flexibly connected and afterwards of gutta percha, was 19 ins. diameter. The suction was also provided with a disintegrator, called an "alligator." To all intents and purposes this successful sea-going, sea-way-working dredge was the same as the "General Comstock," recently built by the Bucyrus Company for Galveston Harbor, or those of Joseph Edwards, lately used on the bars of New York Harbor. Lebby filed a caveat in January, 1856. After the dredge worked out the appropriation under the River and Harbor Act and one made by the State of South Carolina, it was converted to other uses.

N. H. Lebby was one of a group of inventors who formed a distinct era in the industrial history of South Carolina before the war. It is stated that under his direction the smooth bore cannons, seized by the Confederates were rifled. One of his operatives was still living last year.

Hitherto engineering literature has stated that the first application of this kind of dredging was in 1857, at the port of St. Nazaire, France, where, however, a piston pump was employed. This is an error, due to the remote and troublesome time in which Lebby lived and the merely local knowledge of his system. The hull of the "General Moultrie" was built at Greenwich, L. I., and it is not unlikely that several in that vicinity knew its proposed use. General Gilmore's well-known application at St. Augustine, Florida, in 1870, was suggested by the Cullom and Lebby tradition in the engineer corps. It was carried out by Captain (now Colonel) Ludlow, who was stationed at Charleston, after its capture. The full credit for the invention of this type of dredging belongs, beyond question, to Lebby. It is a very short step to take the "General Moultrie," anchor one end, and pipe the material ashore, as she was moved by lines. But it is not known now whether Lebby did more than to have a working model made by Jesse Jones, a local model-maker, and incorporate his ideas in the caveat he filed, which probably lapsed in the midst of the distractions of the Charleston yellow fever epidemic and the political turmoil of the time.

It is not a little singular that at the precise time that Lebby was inventing, planning and building the "General Moultrie," two Prussians should be engaged in the application of the Kreisel pump to hydraulic dredging and the delivery of the material through pipes.

In the latter part of 1855, Frederic Hoffman, Engineer and Manager of the Berlin & Hamburg Ry., was standing on the banks of a canal then being excavated near the Lehrter railway station in Berlin. He noticed that the simple hand pumps for draining the cut brought up considerable sand, and he then conceived the idea of using a steam pump to convey the sand directly to the fill several hundred feet away. He conferred and collaborated with his near friend and neighbor, Louis Schwartzkopff. They adopted the Kreisel pump and made numerous designs, one of which was patented in Prussia, Denmark, England and France in January, 1856, in the first two countries in their joint names, and in the others in Schwartzkopff's name alone. So much impressed were they with the possibilities of the device that Hoffmann resigned his position, and together they tendered for work on the regulation of the Black Elster River. An economical Minister of Works, however, postponed the project, very much to their loss, and Hoffmann turned his attention to other inventions relating to papier-mache and brick-making. In the latter industry he made a great fortune and reputation and was living last year, nearly eighty years of age, still active, and one of the largest manufacturers in Germany. To hold their Prussian patent, which expired in 1861, they worked it in 1856, at the Custrin bridge, to remove a shoal occasioned by the new piers, using a reciprocating-disintegrating tool at the end of the suction-pipe. The shoal was removed to the satisfaction of the Contractor Stein and the Minister of Works, and material was discharged through a pipe-line carried by pontoons a short distance. After Hoffmann

began to develop his patent brick-kiln in 1858, Schwartzkopff still continued to improve the dredge, and in 1858 he applied to the suction a rotary cutter and telescopic pipes, telescoping vertically, almost precisely the same as the device "patented" by Von Schmidt 28 years later in the United States. In this case, however, he swung the dredge radially, instead of swinging the suction pipe, as in the 1856 design patented, to reach the material to be excavated. It was Schwartzkopff's custom to lithograph these designs and print descriptions of this and other applications of his Kreisel-pump, and send them out in letters soliciting business and advocating their use upon rivers and harbors. He also gave the machine the name of the "Hoffmann and Schwartzkopff's Hydraulic Bagger." In 1861 he tendered for their use on the great port of Wilhelms Haven, and, though other methods were adopted because his system was thought too radical, his pumps were used to drain the pits for the masonry walls. After this date, the Prussian patent having expired, he did not push the invention. Not until a paper was read by Hoffmann, before a commercial society in 1870, and fully describing the invention, was the matter revived in Germany. Schwartzkopff died several years ago. Meanwhile, quite independently, Atkinson, in New York, in 1862, and Gwynne, in England, in 1863, patented their applications of a rotary cutter to a suction pipe. In 1864, in Holland, Wm. Freeman patented, a few months before that patent law was repealed, his system of pumping spoil ashore from a dredge through a floating, flexibly connected pipe-line. His partner, Burt, took out an English patent in 1867. These men were contractors on the North Sea Canal at Amsterdam. At first they used chain-bucket dredgers, delivering into the suction of a pump mounted on the side of the hull; but later they built numerous purely suction dredges and used all the elements in combination claimed as the foundation of the art by the American "inventor" who filed applications in 1876 and only suffered the patents to issue nine years later, in 1885.

The radial motion was nearly always effected in European dredge practice by chains. The use of vertical spuds or anchors appears to have originated in America on the Erie Canal, as applied to dredges; but the primeval fisherman who thrust his oar into the mud below his boat, tied the handle to the thwart, and made his skiff to swing in the shallows, while he dredged oysters, probably owns the principle, even though the Californian courts wisely invest a Californian with his mantle.

In 1869 a Baltimorean, Duval, patented a very good suction dredge for use in the river placers in Central and Southern America. From 1870 to 1876, Brodnitz and Seidel, of Germany, built and operated several machines in Germany and Russia, and Burt did the same upon the lower Danube. In 1876 Von Schmidt began his suction dredging operations in California, repatenting the Schwartzkopff published design of 1858, except that he added the unnecessary bow turn-table. In May, 1885, Bowers first appeared and claimed everything about suction dredging except the earth, and has been dredging in the courts ever since. His conception has been dated back by confiding judges to 1864, immolating truth and science on an impossible design. A more extended reading at the proper time might just as well have made this date in the evidence ten years earlier. Then, indeed, one might hail a real inventor. As it is, Bowers is the conceded inventor of a specific form of rotary cutter, which, when built and tried, was a lamentable and utter failure. It was discarded within 48 hours by its unfortunate owner, upon whom devolved the work of remedying through dear experience the vital errors of Bowers designs. Bowers has never executed a dredging contract anywhere at any time. In point of fact, he is not the discoverer or original inventor nor are his claims for originality valid in view of the foregoing and the public, the government, and engineers generally should know these facts, which anyone can verify.

Comparing the present state of the art with that of Lebby and Hoffmann-Schwartzkopff, one may say that Lebby's device has been slightly improved upon by Edwards and Kinipple; that the latest sea-going hopper suction dredges of Kinipple, in England, and the Bucyrus Company, in the United States, are better than Lebby's only as hulls, pumps, engines, screw-propellers, hopper-doors, rubber suction pipe and hangings are better, as a result of the general mechanical improvements of the last 40 years. It is surprising to our modern conceit to realize how well our fathers builded.

As compared with the Hoffman-Schwartzkopff system of 1856-61, it may be said of the modern centrifugal pump that it is somewhat better than theirs, and the old one was directly connected to a high-speed engine. The Atkinson cutter of 1862 is the prototype of the Bates cutter of to-day; the latter performs its office of severing the material within the suction field better than the other because of better specific construction, not of better theory. The Bowers "patented" cutter was designed to meet a mistaken theory, and when practically tried it proved to be worse than useless. The Duval cutter of 1869 is a good one, simple and effective, and was lately employed by Vivian on the Chicago Drainage Canal. The Chaquette cutter of 1862 was a fair tool, especially for clayey soils. The Lynch, Angell, Williams, Bucyrus, Duval, Bates, San Francisco Bridge Co. and New York Dredging Co. cutters are all specific constructions, differing from Atkinson merely in detail of shape and up-building. The Seidel cutters of 1870 are similar to Burt's, but his double shaft cutter, of 1876, used at Riga, is a successful type by itself. The last Von Schmidt machines are almost identical with Hoffmann-Schwartzkopff, of 1858, except that the latter did not use the expanded hood over the cutting blades, and swung the dredge instead of the bow-turntable.

Hoffmann-Schwartzkopff used rubber hose in 1856, and Burt, in 1864, used leather for flexible pipe joints, and no better substitutes have been since evolved. The Hoffmann-Schwartzkopff dredge of 1858 used vertical telescopic suction pipe and parallel cutter-driving-shaft. Von Schmidt and Bowers both sought and obtained patent claims covering these devices many years later. Bates has introduced a vertical telescopic elbow to permit the suction pipe to oscillate in a vertical plane. It is compact and simplifies the train of cutter gears, and it is fundamentally essential to his battery dredge, of which the U. S. "Beta" is a type. Its use has made dredges possible up to a capacity of 20,000 cu. yds. per hour. This joint has been imitated in the Flad Mississippi dredge by beng turned wrong side up.

The Bowers sliding spud was designed for him by Warrington, of Chicago, and costs three times what a better device of Bates costs, or the double spud system of other companies. The Bowers "patented" turntable spud was never built except as a paper structure around which to weave "patent" claims. It could never work practically at all.

Bates is also the author of the nickel-steel single piece open-end rotary cutter, the semi-elliptic and whaleback pipe pontoon, the hydraulic spoil distributor and adjustable baffle-plate, of the self-propelling straightway cutting dredge, the electro-hydraulic dredge, the buoyant ladder and spud devices by means of which these adjuncts are handled by compressed air; and other notable improvements.

Frank E. Lesourd, M. E.,
President and General Manager, New Orleans Contracting & Dredging Co.
New Orleans, La., May 8, 1897.

(In accordance with our usual custom, we furnished proofs of the above letter to the parties who were criticised in it and offered them an opportunity to present replies in the same issue in which the letter was published. We append their letters as follows.—Ed.)

Sir: I have received the proof of a communication which has been sent you for publication, on "Pioneers of Centrifugal Pump Dredging."

I will state that on July 24, 1847, a patent was granted to A. W. and J. H. Von Schmidt for a Rotary Siphon Pump, and many were made and sold. One was used in pumping out the foundation (gravel and sand) of the United States works for a fort at Staten Island, N. Y., then in charge of Col. Delafield, U. S. Engineer Corps. I also constructed one, and this was put into operation on the Brooklyn Dry Dock. Since that time I have made various changes and improvements in rotary pumps; some for raising water only, and others for dredging machines on the hydraulic principle.

In 1874 I made an improvement on my system of dredging, and entered a caveat for the same. In 1876 I constructed a dredger for Thomas H. Williams and Bixler for the building of levees on the San Joaquin River, California. In 1876, also, I applied for a patent, which was granted to me on Dec. 19, 1876, since which time I have taken out altogether nine separate patents, and I claim that the large Von Schmidt dredger has been a success over all others heretofore built in any part of the world. And, while I do not claim the earth, I do claim that I was the first to make hydraulic dredging in the United States a success. I do not wish to take any credit from Schwartzkopff. On the contrary, he is entitled to the discharge pipe, having patented the same in England in 1856. I will say that this patent of Schwartzkoff was not in my case before the court, otherwise the judgment of the court would not have been what it was in the case of Bowers vs. A. W. Von Schmidt.

As it is, the court held that out of Bowers' (126) claims I infringed on 9. The most important was that of Bowers' claim on the discharge pipe, which is about the same as Schwartzkopff's.

In my opinion, Bowers could not patent in a combination patent what was already patented in a foreign country as early as 1856.

The Bates plan of using six suction pipes in place of one is, in my judgment, only an aggregation. The principle is the same in all suction dredgers. Outside of the cutters, cutting the material loose, it is the suction of the centrifugal pump that draws the material in, and by the same agent it is thrown out though the discharge pipe to the place of delivery. There is no such action, as Bowers claims, of an "internal delivery," for when the pump is not in action his cutter will not deliver. In fact, he knows this full well, as on those machines he sold to others, constructed on his plan, the Bowers cutters are not used. So far as I am individually concerned, I wish it to be distinctly understood that I do not claim to be the pioneer inventor of hydraulic dredgers, but that I have been and am an improver; and thus far I will say, and I know from years of experience, that the Von Schmidt dredge has done better work in both hard and soft material than any other machine.

The Von Schmidt machine has only 250 HP., while the Bates machine has 1,700 HP., with six suction pipes and two pumps. In soft material these are capable of handling a large quantity of loose material. What would the six suctions do in hardpan?

In conclusion, all suction dredgers should do work in soft material in proportion to the power used, only that these dredgers are somewhat different in construction, and, as a matter of course, improvements are the order of the day. Yours respectfully, A. W. Von Schmidt,
Civil Engineer.
808 Montgomery St., San Francisco, Cal., May 24, 1897.

Sir: Referring to the article, headed "Pioneers of Centrifugal Pump Dredging," truly "the mountain has labored and brought forth a mouse." To one at all familiar with the United States Patent Law, and the decisions of the United States Circuit and Appellate Courts, this paper needs no refutation. It is not "by inspiring and misleading the public and scientific press" that the writer thereof, or others, can overturn or evade the decisions of United States Courts.

Referring to the suit of Bowers vs. Von Schmidt, he says:

> It will be found that this case was fought between two parties who were patentees, each trying to establish his own patents and carefully excluding what was done in foreign countries long prior to their so-called inventions.

Now here are two attempts to "mislead"—two instances of "misinformation to the press."

First, Von Schmidt was not "trying to establish his own patent," for the simple reason that its validity has never been questioned. No one has a right to use, and I have never claimed the right to use, anything covered by his patents except under authority thereof. Unfortunately for him, he, like Bates, has no broad claim. His patents, like those of Bates and others, are for specific details and devices which cannot be used without, at the same time, using what is not covered by their patents, but is covered by mine. I claimed and proved that Von Schmidt infringed my patents. He claimed and sought, without success, to prove that my patents were invalid.

Second, Von Schmidt did set up everything that he could find that "was done in foreign countries * * * prior to the date of his" real, not "so-called inventions," that he thought might serve to limit the scope of my patents, as, for instance, "foreign" Letters Patent to Thomas Burt, No. 207, of 1867; to Henry Oliver Robinson, No. 2429, of 1868; and the Gwynne device used at the Chatham Dock Yard in 1874; while the date of the Von Schmidt patents in controversy did not go back of May, 1883. But Von Schmidt set up American devices several years earlier than any cited by Mr. Lesourd—as, for instance, the Hart dredge used in 1848 and the Frasier described in the "Scientific American" in 1852. He also set up the Atkinson patent of 1863, and the Duvall patents of 1868 and 1869, to which Mr. Lesourd has referred, also the Fonda and Lyons of 1854, and the Angell patents of 1882 and of later dates.

He did not set up the impracticable device and abandoned experiment of Schwartzkopff and Hoffman, though, according to your correspondent, they "worked it in 1856," the year their patent came out, and never "worked it" again. No wonder they never "worked it" again, and no wonder "his system was thought too radical." Any system that had proven a failure would naturally be thought "too radical." Nor did Von Schmidt set up any of the other abandoned experiments to which your correspondent has referred. His attorney was not ignorant of the fact that unsuccessful and abandoned experiments could not anticipate a successful patented invention. He was also aware that none of the alleged anticipations not set up, in the Von Schmidt case, showed the combination of any one of my claims. Why does your correspondent confine himself to glittering generalities and set his own unsupported ipse dixit against the decisions of the United States Courts? Surely he owes to himself the production of some proof—some quotation from patents—some reference, that can be verified, to something showing at least some one of the "broad claims" to which he has referred or to something showing at least one of my "broad claims." And why does he conceal from your readers the fact that the great Schwartzkopff invention "so-called" was carefully considered by the United States Patent Office before granting me Letters Patent, and the farther fact that it was set up by the San Francisco Bridge Co. and the New York Dredging Co. in the recent suit brought by me against those companies in the United States Circuit Court at Tacoma? In that case Judge Hanford, after carefully and critically considering this Schwartzkopff patent, as well, also, as many other "foreign" patents not set up in the Von Schmidt case, judicially determined that notwithstanding these patents I was entitled to an injunction against those companies and granted an injunction, which is now in full force and effect against both of these companies throughout the whole territory owned by the Bowers Dredging Co.

He says: "Neither Bowers nor Von Schmidt is entitled in any sense whatever to more than trifling and unimportant claims on two or three specific forms and mechanical variations."

Doubtless the judges of the United States Courts will stand abashed before this new expounder of the law—this second "Daniel come to judgment"—for though neither Von Schmidt nor Bates could obtain anything "more than trifling and unimportant claims on two or three specific forms and mechanical variations," I was so fortunate as to obtain 380 claims, many of them exceedingly "broad" ones; and these broad claims have been sustained by those "confiding judges," as he sneeringly calls them, now increased to five, since Judge W. W. Morrow has just granted an injunction against John Hackett and the Pacific Coast Dredging & Reclamation Co., one of which judges, the Hon. Joseph McKenna, is now Attorney-General of the United States.

In my motion for injunction against John Hackett and the Pacific Coast Dredging & Reclamation Co., great stress was laid by counsel for defendants on the Schwartzkopff patent as anticipatory of some of my claims; but in his decision granting the injunction, Judge Morrow is strong and clear in his refutation of this contention.

He says: "The Courts have been persistently invoked to establish and rivet a patent monopoly under patents granted by the Government thirty years after every broad combination claim had been successfully, scientifically and profitably demonstrated by the real inventors."

Now here in a single paragraph are no less than three instances of "misinformation to the press." Not one of my broad claims had ever been either "successfully," "scientifically" or "profitably" demonstrated prior to my invention thereof, and only one or two had been tested at all prior to my application for patents. He cannot point out one of my broad claims anywhere even remotely suggested prior to the date of my invention. If he could, would he content himself with the citation of nothing save what he himself shows to have been merely a few abandoned experiments and one or two moderately successful sand pumps? One would infer from his article that I claimed to be the inventor of vertical anchors, centrifugal pumps and sand pumps. This seems to be three more attempts at "inspiring and misleading the public and scientific press," for he certainly knows this is not true.

He speaks of "the real inventors," of whom he says "two only now survive." Why does he not give us their names that we may do them honor? And why does he rehash the stale matters of Andrews, Gwynne, Appold, Schwartzkopff, Hoffman, Freeman, Burt, Atkinson, Duvall and others? Is it possible that he has only just discovered them? And was it his assumption that the United States Courts and others were equally ignorant that caused his fling at the "confiding judges" who found my invention to date back to 1864?

He says:

As it is, Bowers is the conceded inventor of a specific form of rotary cutter, which, when tried, was a lamentable and utter failure. It was discarded within forty-eight hours by its unfortunate owner, upon whom devolved the work of remedying through dear experience the vital errors of the Bowers design.

This paragraph contains no less than four instances of "misinformation to the press."

First. I have no claim in the patents referred to for any kind of a cutter and the forms subsequently patented by me have never yet been before any court but are contested by every infringer who is using them.

Second. The cutter referred to was not a failure.

Third. It was not discarded at all but was used until entirely worn out.

Fourth. Changes made in subsequent cutters for the Bowers Dredging Co. were trivial, unimportant, made at my suggestion, and from drawings furnished by me.

The facts concerning the cutter referred to are these: I was told that it was to work in soft material and to save cost I furnished an iron cutter cast in a single piece with circumferential rings bevelled but not provided with sharp cutting edges. This was tested by me and worked well in soft, loose material, such as that for which it was designed. But there was very little of such material where the dredge was put in operation. The greater portion was hard, compact sand for which a cast-iron cutter, having cast-iron blunt edged circumferential rings and cutting blades was not suitable, because none of the cutting edges could be made sufficiently thin and sharp. I, therefore, removed some of these rings myself and directed the removal of the rest. After this had been done the performance was as follows:

In the harder portion of the excavation, the machine cut, raised and delivered through 258 ft. of 18-in. pipe 4.19 cu. yds. per minute, with an expenditure of 188.79 I. HP. When working 5 ft. from the surface, the delivery was 7.66 cu. yds. per minute and the I. HP. 192.75. At 3 ft. from the surface in the less compact material the delivery was 12.79 cu. yds. per minute, with an I. HP. of only 179.98. On a run of 5 hours and 20 minutes, the output was 3,030 cu. yds. or an average of 9.46 cu. yds. per minute. This statement of its performance is taken from a letter written by George L. Pierce, an engineer, who assisted in making these tests and is found on p. 266 of Engineering News of March 23, 1889.

It was not until after all this had been done and the foregoing tests made by me and Mr. Pierce that the dredge was turned over to Mr. Bates (then manager of the Bowers Dredging Co.), who subsequently handled about 30,000 cu. yds. of the same hard material without further change of the cutter and then took the dredge to Tacoma, where he wore that cutter out. The work at Tacoma was in different though less difficult material, and for this material I recommended a steel cutter with narrow cutting blades and furnished a blue print of such a cutter, retaining the original drawing. Instead of substituting this latter, the width of the leaves or cast-iron blades of the first cutter were reduced to about the dimensions suggested by me by cutting off from the inner edges of these cast-iron blades. Thin wrought-iron bars with cutting edges were used to replace the thick iron circumferential rings removed by me, and this amended cutter was used, contrary to my suggestion, until entirely worn out. Not until this had occurred did Mr. Bates order from me the other, which I had made for him in San Francisco, from my own drawings and forwarded to him. This was known as "the little cutter" and gave the best results of any ever used by Bates, the Bowers Hydraulic Dredging Co., or any one else, according to the best of my knowledge and belief, though some others differing but little from this were afterwards used by Bates and others on the Chicago Drainage Canal. The cutting blades of "the little cutter" projected beyond the lower end, which was conical in shape and without the circumferential rings, or the scoops shown in the drawings of my patent. On visiting the dredge at a later period I directed large holes to be cut in this lower conical discal end and this was found to be an improvement. These changes made by me or at my suggestion and from my working drawings are all of the changes of any importance that were ever made for the Bowers Dredging Co., and I still have the original drawings from which these cutters and changes were made. These facts are within my own personal knowledge and experience and I therefore state them authoritatively. On the other hand, Mr. Lesourd has no personal knowledge of these facts and has been misled by the same untrustworthy hearsay reports of interested parties, which have led him into the many other erroneous statements contained in his letter.

It is true that I have never personally executed any dredging contract; but Mr. Lesourd cannot be ignorant of the fact that my company, "The Bowers Hydraulic Dredging Co.," and other companies licensed by me, have executed many large contracts and are now executing other large contracts. Numerous other misstatements in his letter are too trivial to merit notice. He writes, as have others, Lindon W. Bates, for instance, when infringing my patents. I shall look into this and if he is so infringing, shall refer the matter to the arbitrament of the Courts, where it is to be hoped that the solemnity of judicial procedure will secure from him greater accuracy of statement.

A. B. Bowers.

New York, June 5, 1897.

Notes and Queries.

L. & M. write they are in dispute as to whether there is any point of a wheel of a vehicle "which travels faster than any other when the wheel is in motion," and appeal to us for a decision. Every point on the wheel has a uniform motion forward and has also a rotating motion about the axle, the velocity of which varies according to the distance of the point from the center. The absolute motion of any point on the wheel at any instant, with respect to the earth is found by combining these two motions. When a point on the wheel is vertically above the axle, the two motions are added together to obtain the motion relative to the earth. When it is vertically below the axle, the motions are in opposite directions and one is subtracted from the other.

BOOK REVIEWS.

THE STREET RAILWAY SYSTEM OF PHILADELPHIA: Its History and Present Condition. By Frederic W. Speirs, Ph.D., Professor of Economics and History, Drexel Institute, Philadelphia. Fifteenth series, Nos. III., IV. and V., Johns Hopkins Studies in Historical and Political Science; H. B. Adams, Editor. Baltimore: The Johns Hopkins Press. Cloth; 6 × 9½ ins.; pp. 123. Price, $1.

Street railways are assuming a place in both engineering and municipal government not dreamed of at their inception. The Philadelphia street railway system is one of the largest in the world, and according to the author of this book yields the city a revenue, reduced to terms of gross receipts of the company, not equalled by more than two other cities in this country, although other cities have been more favored in the matter of low fares and transfers. A large number of companies have been chartered and have constructed lines, but with one exception these are now all included in the system of the Union Traction Co.

This volume traces the physical, financial and corporate development of the street railways of Philadelphia in an interesting and forcible manner. Separate chapters are given to "The Price of Franchise Privileges"; "Public Control"; "Municipal Ownership," including under this head the provision of franchises for purchase by the city at the original cost of construction; "Corporate Influence in State and Municipal Government"; and "The Railway and Their Employees."

The principal return to the city for street railway franchises has been from street paving, and the experience in this connection are so instructive and suggestive that citations from the book, accompanied by editorial comment, are given elsewhere in this issue.

Mr. Speirs' book will be welcomed by many who are interested in the relations between American street railway companies and municipalities, have found with regret that there is available but little definite information relating to the subject. A somewhat similar study of the street railways of Cleveland* was recently published by the American Economic Association, and some years ago the same association published quite a bit of information regarding the street railway franchises of a number of American cities, in connection with a study of franchise companies and municipal ownership made by a committee of its members.† Aside from these three publications, the literature of the subject is scattered through a variety of publications, and is not very extensive at that. The Philadelphia and Cleveland monographs are the only complete studies yet made of the street railway systems of American cities, so far as we can learn.

WATER AND PUBLIC HEALTH.—The Relative Purity of Waters from Different Sources. By Jas. H. Fuertes, M. Am. Soc. C. E. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 5 × 7½ ins.; pp. 75; 64 figures in the text and six folding plates. Price, $1.50.

Aside from some brief general considerations regarding the spread of typhoid fever, this volume is mainly taken up with the relation between pure water and typhoid fever, some space being also devoted to the effect of sewerage systems upon the disease. The subject is to a large extent treated by presenting typhoid death rates for 76 American and foreign cities, grouped in accordance with the purity or probable purity of the respective water supplies. The statistics cover the six years, 1890 to 1896, inclusive, and each of the cities given has populations of more than 50,000. Diagrams are used freely, a large number of small diagrams being presented to show the typhoid fever death rate and the rate of rainfall in American cities. In ten cities there is an apparent close connection between heavy rainfall and typhoid fever, which can be accounted for, at least in part, by pollution of the water supplies by surface washings during heavy rainfalls. In only one city does typhoid fever increase with a light rainfall. In the remaining cities, about 40, there is no apparent relation between rainfall and typhoid. Tables showing the rainfall for six years in a number of cities are given in the book.

As a whole, the volume emphasizes the great value of pure water as largely reducing the dangers from typhoid fever; points out that too much reliance must not be placed upon the self-purification of sewage-polluted rivers, nor sedimentation and other natural causes in storage reservoirs; and concludes by stating that filtration may be relied upon to keep the typhoid death rate down to from 0.3 to 2 per 10,000, where the water is no more badly polluted than the Rivers Elbe, Thames, Danube and Merrimac.

ANNUAL CONVENTION OF THE MASTER MECHANICS ASSOCIATION, OLD POINT COMFORT, VA.

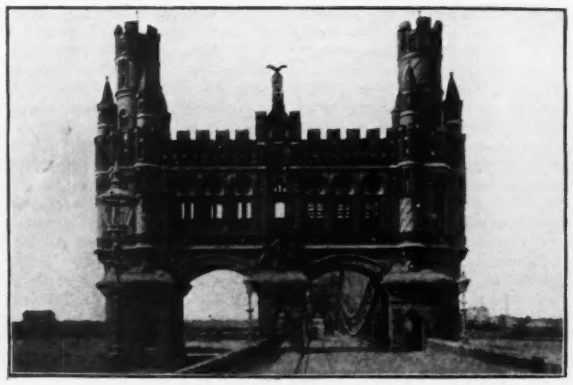
Three days only elapsed beteen the closing session of the Master Car Builders' convention at Old Point Comfort, Va., and the opening meeting of the Master Mechanics' Association at the same place, during which time the members remaining for the second convention devoted themselves to the excursions and other entertainments provided by the visiting supply men. A partial change in the personnel of the membership was about the only noticeable difference between the opening sessions of the two conventions, and when the Master Mechanics assembled on June 16, they settled down to regular business with but very few preliminaries.

In a brief opening address Col. Hasbrouck, U. S. A., of Fortress Monroe, welcomed the convention to Old Point Comfort. After a few words of thanks in response to this welcome, Mr. R. H. Soule (Norf. & Wn.), the President of the Association, presented his opening address to the members present. Mr. Soule briefly traced the growth of the Association from its first session and called attention to the great progress made in railway motive power during that time. He congratulated the Association particularly upon its financial and numerical strength. Speaking briefly of the scholarships held at Stevens Institute by the Association, he noted with regret that there seemed very little tendency on the part of those qualified to avail themselves of the gift. Referring to some of the more technical features of the work in which the members of the Association were engaged, he spoke particularly of the growing tendency to use higher steam pressures in locomotives.

*"The Street Railway Problem in Cleveland." By Wm. Rowland Hopkins. Vol. I., Nos. 5 and 6, Economic Studies American Economic Association.

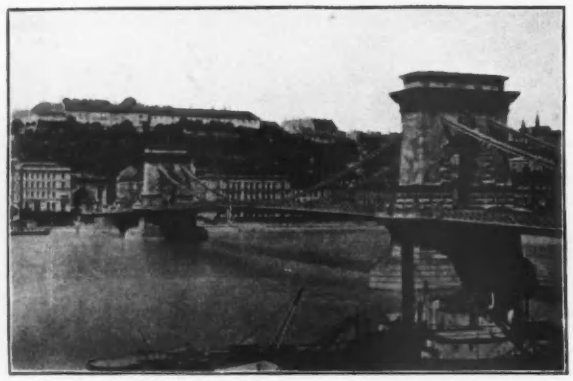
†"The Relation of Modern Municipalities to Quasi-Public Works. By H. C. Adams and others." Vol. II., No. 6, Publications, American Economic Association.

THE TOWER BRIDGE OVER THE THAMES, LONDON.



PORTAL OF NEW BRIDGE OVER THE ELBE, HAMBURG, GERMANY.

KARL'S BRIDGE O... TH... PRAGUE, BOHE...

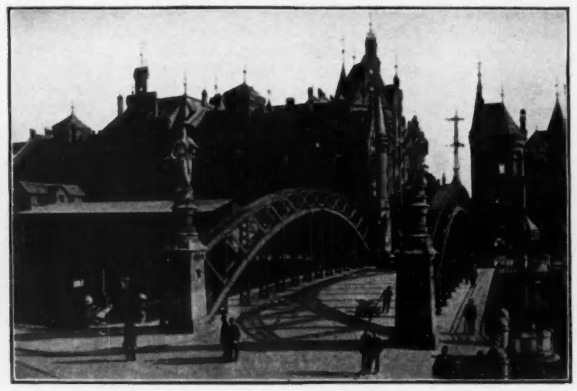


CHAIN SUSPENSION BRIDGE AT BUDAPEST HUNGARY.

OLD BRIDGE OVER THE ELBE AT HAMBURG.

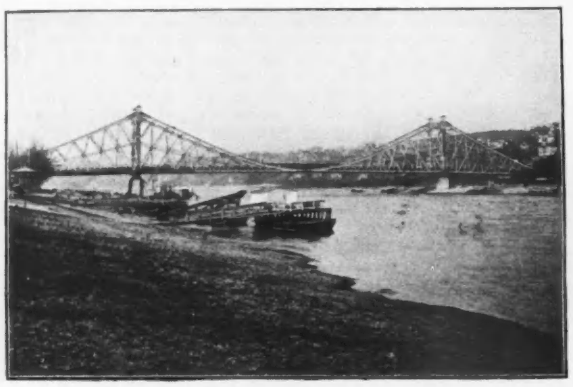
MARIA THERESA COURT AT ... FOR...

CHAIN SUSPENSION BRIDGE BETWEEN BODENBACH AND TETSCHEN, BOHEMIA, OVER THE UPPER ELBE.

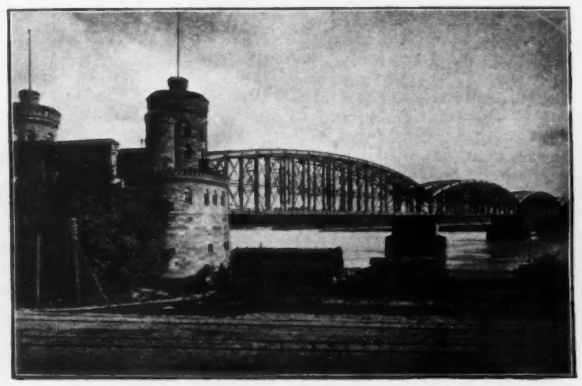


KAISER BRIDGE AT HAMBURG, GERMANY.

THE ELIZABETH BRID...



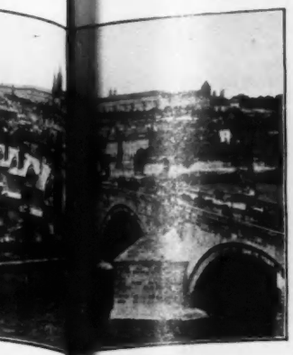
CANTILEVER BRIDGE BETWEEN LOSCHWITZ AND BLASEWITZ, SAXONY, OVER THE ELBE.



RAILWAY BRIDGE AT MAINZ, GERMANY.

FRIEDRICH BRIDGE ... BERLIN, ...

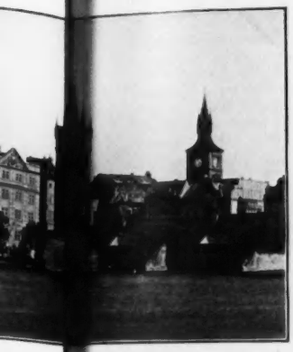
THE ESTHETIC ELEME...



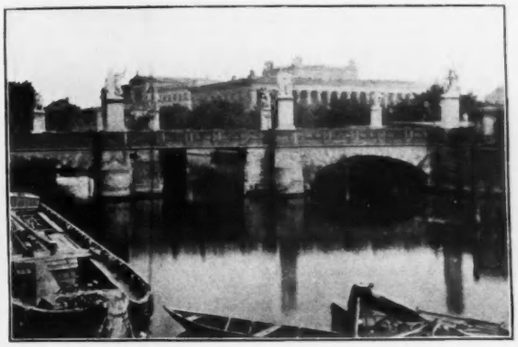
'S BRIDGE O THE MOLDAU, PRAGUE, OHEMIA.

OLD BRIDGE AT FRANKFORT-ON-MAIN, GERMANY.

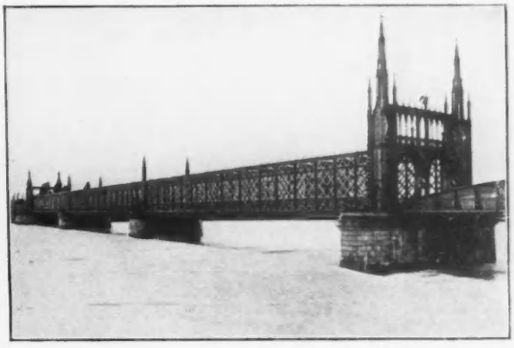
RAILWAY BRIDGE AT COBLENZ, GERMANY.



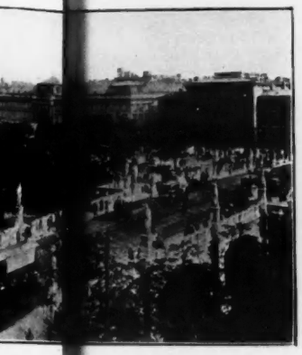
A COURT AT PORTAL OF KARL'S BRIDGE.



THE SCHLOSS BRIDGE, BERLIN, GERMANY.'

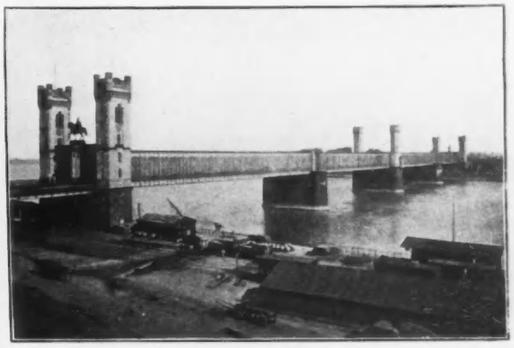


RAILWAY BRIDGE AT KEHL, NEAR STRASSBURG, GERMANY.



ABETH BRIDGE, VIENNA, AUSTRIA.

NEW CAROLA BRIDGE OVER THE ELBE, DRESDEN, SAXONY.



RAILWAY BRIDGE OVER THE RHINE AT COLOGNE, GERMANY.

CH BRIDGE AND THE BOURSE, BERLIN, GERMANY.

NEW STEEL ARCH BRIDGE, MAINZ, GERMANY.

PORTAL OF RAILWAY BRIDGE AT COLOGNE.

ELEMENT IN BRIDGE DESIGN.

and believed that the maximum economy of the locomotive would be found with a pressure of at least 180 lbs. During the past year the efforts to reduce the weight of reciprocating parts had continued, but he believed that the end of improvement in this direction had not yet been reached. The tendency in valve practice was toward decreased lead and increased inside clearance. The tonnage rating of locomotive performance had become an accepted feature of railway practice. It appeared that the compound locomotive was gaining favor every year. During the year just past the hard times had been severely felt by the motive power departments of railways, but he believed that a great deal of good in some ways had resulted from the misfortune. Master mechanics had been obliged to economize and to study ways and means of doing work so carefully that they were to-day in many respects more proficient and valuable men than if they had never had cause for trying their wits against adverse conditions. In closing, he referred to the advance which was being made in the introduction of electric propulsion upon railways and advised that a committee be appointed to report upon the status of this matter at the next convention.

The reports of the Secretary and Treasurer showed the Association to have a membership of 620, and, with all debts paid, to have a sum of $1,659 in the treasury. Upon vote the dues were made, as usual, $5 for the coming year.

Following these reports quite an amount of routine business was disposed of, the most important of which was the changes in the constitution providing for the addition of a Third Vice-President to the officers of the Association, and the modification of the article governing the bestowal of the Association's scholarships so that after preference had been given to employees and sons of employees of the mechanical departments of railways and yet vacancies were left they could be filled by railway employees of any department. On motion of Mr. W. H. Lewis (Chic., Bur. & No'n), resolutions were passed instructing the Executive Committee of the Association to secure, if possible, an arrangement by which both the Master Car Builders' and Master Mechanics' conventions could be held and finished the same week. At the present convention the sentiment has been unusually strong that something should be done to reduce the length of time which the members of both associations were compelled to be away from home in order to attend both conventions. A reform tending toward the end outlined by the resolutions would, we believe, find a majority in favor of it, both among the members of the Associations proper and among the many outsiders whose business compels them to attend the conventions. An idea of the time wasted, as one member expressed it, in "frivolities," may be had from the statement that at the present two conventions there will be seven 4½-hour sessions in ten days, all the remainder of the time being devoted to excursions and entertainments. It is the exceptional business man or railway mechanical officer who has the time at his command to spend in this way, and the applause which followed the reaching of Mr. Lewis' resolutions and the unanimity with which they were approved by the Association indicate that the members are becoming alive to the fact.

As at the sessions of the Master Car Builders, the noon hour of the sessions of this Association is devoted to topical discussions of questions raised by the members. This order of business followed the more formal routine work, but as these subjects can be handled more briefly and conveniently for all sessions at one time the discussions of the opening session will be postponed until a later part of these proceedings.

Following the topical discussions came the discussion of the 1896 report of the Committee on Exhaust Nozzles. This was only partly completed at the opening session and was ordered continued at the second session, and in order that it may be presented at one time its report will be deferred until our next issue, when the report of the remaining sessions of the convention will also be given.

ANNUAL CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The twentieth convention of the National Electric Light Association was held at the International Hotel, Niagara Falls, N. Y., June 8, 9 and 10.

The first meeting was called to order at 10.45 a. m., June 8, by the President, Mr. Frederic Nicholls, who delivered a brief address, in which he called attention to the actual materialization of the long-projected scheme for utilizing the water power of Niagara Falls, to the great advances made in the development of electric transmission, and to the growing importance of the manufacture of electrical machinery and apparatus.

The report of the Committee on Data was presented by Mr. H. M. Swetland, chairman of the committee, and we give an abstract of this report in another column. The report was accepted and the committee discharged with a vote of thanks to Mr. Swetland for the excellent work done by him. The report of the Committee on Finance was then presented by Mr. John A. Seely, chairman of the committee, and showed a favorable state of affairs as compared with the previous year.

The afternoon session was called to order at 2.45 p. m., and the first matter for consideration was a letter from the Erie Gas Engine Co., stating that broad claims had been made to the effect that gas engines were not adapted for electrical stations, and the company asked that a committee of the Association should be appointed to make careful tests of this company's engines. By resolution this communication was laid on the table.

Invitations to the Association to hold its next meeting at Omaha, Neb.; Indianapolis, Ind.; Nashville, Tenn., and Old Point Comfort, Va., were presented and all were referred to the Executive Committee.

A paper on "The Establishment of a Base Price for Current" was then read by Mr. J. B. Cahoon, of Elmira, N. Y., which commenced by the broad statement that it is only the contracts for city lighting by arc lamps which enable electric lighting companies to do business successfully, and that if these were taken away, leaving only the incandescent lighting and power current, the central stations could not make a profit. The writer adopted the price of coal as a basis of the price for current, and closed his paper by remarks upon the necessity of adopting uniform records and blanks so that the results of operation at different stations can be intelligently compared.

Mr. Bates, in discussing this paper, stated that much of the information given and published is practically valueless, as no comparisons can be made, owing to the incompleteness and lack of uniformity in the records. A great deal is published in the electrical journals about the high records in the operation of large central stations, but in point of fact there are more difficult conditions to be met with in operating small stations successfully, and many of these stations are examples of good and intelligent management.

The topic of "Theft of Current and How to Deal With It," was then taken up. In introducing the subject, the president, Mr. Nicholls, said that there were very few states having a statute covering the theft of current, and he suggested that a clause covering this crime should be added to the criminal code of every state. Canada has a law providing for the punishment of theft of current.

Mr. T. C. Martin presented some notes as a draft of a proposed law. Mr. Bates said that there was more trouble from tampering with the measuring instruments than from actually tapping the wires, and the law should be broad enough to cover both forms of fraud. Two members called attention to the fact that Massachusetts has a law covering the theft of gas and electric currents, while Michigan proposes a law covering the theft of water, gas and electric current. Another member, referring to the ignorance of judges, magistrates, city officials and others in regard to the commercial side of electric lighting and the cost of producing the electric current, said that his company had found good results follow from inviting the city officials, school teachers, citizens, etc., to visit the central station and learn how the current is generated, and how electricity is applied, the company going so far as to give exhibits of X-ray apparatus, etc. This conciliatory and educationary policy might well be adopted in other cases. A resolution was adopted directing the chairman to appoint a committee of three to report upon the question of theft of current, and to draft a bill providing for punishment for such theft.

The report of the Committee on Rules for Safe Wiring was read by Mr. William Brophy, being the final report on a subject upon which the Association has been at work for some years. Mr. Nicholls explained that the matter had been now brought to a successful conclusion, after long work against great difficulties. At first the insurance companies refused to listen to any suggestions from the electric light men, but the rules are now used by a large number of underwriter's associations. The report was received and adopted, and, on motion, the Association unanimously adopted the finally amended rules as presented in this report.

A paper on "Municipal Lighting" was then read by Mr. W. Worth Bean, of St. Joseph, Mich., who made a strong attack against the operation of electric light plants by cities, claiming that in no case was it actually economical, though it was made so to appear by incorrect methods of accounting.

He argued that municipal ownership of electric light plants was contrary to the spirit of republican institutions and that the government ought not to "enter the field of competition." We quote further as follows:

> Municipal ownership is unjust to the electrical plant now in the field. The central station man has, through his industry, ingenuity and executive ability, built up a large enterprise. The city has invited him to invest thousands of dollars, not only of his own money, but also the money of its own citizens, with no immediate show of dividends, and, in some cases, barely sufficient income to pay the running expenses and interest on the bonds during a period that will amount from one-half to the whole of the average amount of time allowed for depreciation of the plant. The central station man during this time has been harrassed with the anxiety of meeting the fixed charges, maintaining the credit, providing a reserve fund to meet loss by fire, wind storms and burned-up apparatus, and cheering up despondent stockholders who have nothing to show for their money but the rosy-hued prospect that, at some time in the near future, there will be an adequate dividend to compensate them for their risk, and now, when these hopes are about to be realized, in a modest degree, they are confronted by municipal ownership. He must either compete with the city—which, through ignorance, will furnish lights below cost—or sell out. The latter proposition is impossible, for he can not hope to dispose of a plant that has depreciated 50 or 75% without great loss, therefore he is compelled to continue in business with his former heaviest consumer, now his chief competitor. * * * * * * Central station men who have been in the business for a long time, and who have had years of experience, are, without doubt, the most competent to give the best service of the times. He surrounds himself with expert electricians and a corps of able assistants who have been educated in the business and retain their position by the strictest attention to duty. He is continually devising means for improving his service, not only in employes, but also in the latest improved machinery. On the other hand, municipalities change their officials frequently, and new men take control. Councilmen who oftentimes are not even good business men, and have no knowledge of apparatus and electrical affairs, pass on the purchasing of supplies and the competency of electricians and engineers, deposing experienced incumbents and apportioning political plums to friends of but ordinary ability. The men now in control attempt to compete with electrical experts and competent engineers of long experience, and about the time when they are beginning to understand their plant and how to save loss—in a year, or possibly two—the council changes, and they must step down to make way for those of even less ability.

Mr. Bates said that Detroit was the only city having municipal lighting which issued a report in any way reliable, and he warned members that that city had been driven to adopt the system in its own defense. He believed Mr. Cahoon had made a mistake in his paper (quoted above) in claiming that the municipal contracts were all that produced revenue. The natural inference was that the city had to pay the expenses and profits of the company, which he considered to be an improper way of stating the case. Central station men should strive to show the city authorities that they are operating reasonably and economically.

The meeting then adjourned and a large party proceeded to the power house of the Niagara Falls Power Co.

The morning session on June 9 was not called to order until 11 o'clock, and the first paper presented at this session was on "The Niagara Power Transmission Line," by Mr. J. G. White, of New York. This transmission line has already been described and illustrated in our columns. The paper called forth some discussion as to the value of transmission lines, and Mr. Bates thought that in most cases the central station system would be the best, partly on account of the liability to accident or failure on the long distance line. Partly for this reason he thought it would be ultimate economy to have the line underground, as no system of lightning protection can be sure and certain. The cost of right of way of sufficient width to prevent trees from falling on the line was also referred to, and other speakers thought that there are but few cases where the long distance transmission will be as efficient as a central station. In reply to enquiries, Mr. White stated that insulators can be replaced on the Niagara line without shutting off the current, if the cable is not tied to the insulator. The cable is raised by an insulator on a long pole, so that the defective insulator on the crossarm can be replaced. He exhibited some of the crossarms and insulators of this line.

The next paper was on "Profitable Extensions of Electricity Supply Stations," by Mr. Arthur Wright, of London, England. Its main points were the extension of electric lighting to small stores and to domestic uses, and the adoption of a system of graduated changes by which every consumer should pay proportionately towards the expenses and profits of the electric company. In his opinion managers frequently make the mistake of catering mainly to the large consumers, and regard large bills as necessarily meaning large profits. The charges should be proportionate to the costs, and in this way many small consumers may find it better and more economical to use electric light than gas. His own company's charges are much less than the charges for gas. He spoke strongly in opposition to isolated plants, which are becoming so general. In using his system of a graduated scale of charges he has special meters which show the amount of current to be charged for at high and low rates.

In the discussion, Mr. Bates strongly disapproved of cutting rates for electricity below the prices of gas; the gas companies must be competed with, but he considered it very bad policy to cut the prices, as spoken of by Mr. Wright. He did not fear the gas plants as much as the isolated electric plants in large stores and office buildings. As to the rates, he favored a uniform rate, but considered it a most desirable policy that a contribution to a "depreciation, repair and reconstruction reserve fund" should be set aside monthly, so as to provide for keeping the plant up to modern conditions and requirements. Other members approved of Mr. Wright's system of charges, and stated that if the central station men regulated their charges merely by the price of gas they could not hope to compete with the isolated plants. Electric light can be used in many places where the use of gas is impossible on account of the generation of heat and the vibration of the atmosphere. The policy of catering for the small consumers opens up a new course which will be followed out very extensively in this country. One member stated that at Fredonia, N. Y., when the electric railway started a lighting plant a few years ago the gas company was charging $2.50 per 1,000 cu. ft. The charge of electric lighting was so much lower that the price of gas was cut to $1.50, and on that being met, it was cut to $1, the cost of both gas and electric lighting being then kept at about that figure. At these rates the gas company lost $1,000 a year, and the electric company $600 a year. The speaker had bought up both plants and was trying to find some way of raising the rates without losing the customers.

At the afternoon session Prof. Charles A. Carus-Wilson, of Montreal, read a paper on "The Induction Factor, a New Basis of Dynamo Calculation and Classification." It was largely mathematical and analytical, and there was no discussion. Prof. Elihu Thomson, of Lynn, Mass., who was received with enthusiasm, then presented an abstract of a lengthy paper on "Recent Progress in Arc Lighting," in which the use of the alternating current and enclosed-arc lamps were given considerable attention. The use of alabaster and opal globes to diffuse the light and to absorb the disagreeable violet rays was referred to, but such globes absorb 45 to 65% of the light, as against 10 or 12% for clear globes. The luminous yield of enclosed-arc lamps is really but little better than that obtained in incandescent lighting, but he thought that the whiteness of the light and the daylight effect obtained would be a sufficient reason for the large introduction of enclosed arcs, now that the lamps do not require frequent trimming and attention. There was no discussion on this paper.

A paper on "The Daylight Work of Central Stations," by Mr. T. C. Martin, of New York, was then read by title, discussion being postponed in order to enable the convention to visit the works of the Carborundum Co. Mr. Martin's paper opened by the statement that the development of the central station industry has been in some respects a failure, and that better results would follow an attempt to utilize the plant for 24 hours per day instead of regulating it by the moonlight schedule. In 1896 there were 2,400 central stations in operation in this country, 1,195 of which were limited to night work. He referred to the supply of current for power purposes in large cities, and advocated the more general use of storage batteries to help out the station plant, as at the Duane St. station in New York. The applications of electricity to cooking operations, and to heating for cars, residences and for manufacturing purposes were also referred to, the latter including glue pots, silk-finishing rolls, 387 curling-iron sets in the Waldorf and Astor hotels, rubber tire vulcanizers, etc.

In the evening Mr. L. B. Stillwell gave a lecture in the Park Pavilion on "Niagara Power," illustrated by stereopticon views.

On Thursday morning, June 10, a paper on "Polyphase Motors" was read by Mr. B. F. Lamme, of Pittsburg, and the reading occupied so much time that on its conclusion the rest of the programme was postponed in order to make time for an executive session. It has been pointed out again and again that long papers should never be read in full at such meetings, as they take up time which might better be devoted to discussion or to other papers, while it is impossible to keep the interest and attention of the audience for more than 20 or 30 minutes at a stretch. Nevertheless the chairman permitted more than an hour to be occupied in the reading of this one paper and the explanation of its numerous diagrams, and as it was not of a character to be discussed off-hand the meeting adjourned as soon as the paper was concluded.

At the afternoon session Mr. C. F. Scott, of Pittsburg, presented a paper on "Rotaries for Transforming Alternating into Direct Current," upon which there was no discussion. The report of the Committee on "Standard Candle-Power of Incandescent Lamps" was then presented by Mr. Ayers, explaining the steps which had been taken in conjunction with a committee of the American Institute of Electrical Engineers in deciding upon a standard of light and a standard method of testing. The report was accepted and the committee continued. This ended the meeting.

There was a fairly extensive exhibition of electric lighting equipment, including mainly lamps and fittings, and the most noticeable feature of the exhibit was the number of patterns of enclosed-arc lamps, representing a type of lamp which is rapidly coming into use.

The following officers were elected at the executive meeting on June 10: President, Samuel Insull, of Chicago, Ill.; First Vice-President, A. M. Young, of Waterbury, Conn.; Second Vice-President, George R. Stetson, of New Bedford, Mass.; Executive Committee, Frederick Gilbert, of Boston, Mass.; W. Worth Bean, of St. Joseph, Mich.; M. Stevens, of Elizabeth, N. J., and W. McLea Walbank, of Montreal.

CONVENTION OF THE MASTER CAR BUILDERS' ASSOCIATION AT OLD POINT COMFORT, VA.

(Concluded.)

At the opening of the second day's session, discussion was renewed upon the report of the committee upon "Automatic Couplers," presented during the preceding session, but little information was developed unless it was that a strong difference of opinion and experience prevailed regarding the value of turning down the ends of the yoke in addition to the usual rivet connections. Numerically, the convention seemed to favor the turned down lip as a construction which added considerably to safety and yet increased the cost but little.

Uncoupling Arrangements for M. C. B. Automatic Couplers.

At the 1896 convention of the association, a committee report was presented which concluded that the design of an uncoupling device which could be used as standard with all forms of M. C. B. couplers was impracticable. After some discussion the committee presenting this report was continued, with instructions to present at the convention of 1897 a design which would answer for a large number, if not all forms of couplers, it having appeared from the discussion that such a course would be possible. As a result of its work this committee presented designs for lever, clevis, clevis pin, link and brackets for supporting the rod, which it believed could be applied to all ordinary cars and could be used with any M. C. B. coupler in which the lock was located in the top plane of the coupler head and was operated by a vertical movement of the lever arm. These designs are shown by Figs. 1 and 2, which are explained by the committee as follows:

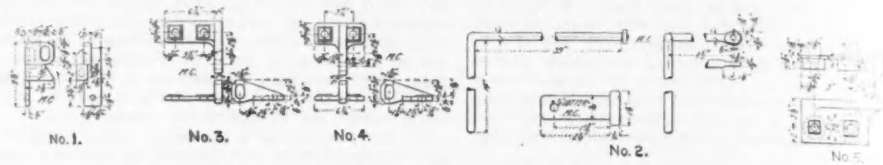


FIG. 1.—STANDARD UNLOCKING ATTACHMENTS FOR M. C. B. COUPLERS, RECOMMENDED BY A COMMITTEE OF THE MASTER CAR BUILDERS' ASSOCIATION.

Diagram No. 1 shows the application of the proposed standard parts to a car with concealed end sills with the parts of the dimensions and located as shown on "Plate B, Recommended Practice for Attaching Automatic Couplers to Cars," arranged to operate the lock in a coupler having the lock located on the vertical center line of the coupler.

Diagram No. 2 shows the application to the same design of car with the center of the lock located 3 ins. from the vertical center line of the coupler. Within these limits are located the locks on the great majority of couplers in service.

Diagram No. 3 shows the application to a car having projecting end sills. The bracket supporting the end of the release rod farthest from the coupler is provided with a projection to enable the lock of the coupler to be held in the raised position by pushing the rod toward the center of the car, after being raised, until the outer arm engages the projection, a feature which with many designs of couplers is necessary.

The dimensions of the parts as shown will be suitable for all cars with dead blocks of the dimensions as shown on "Plate B, Recommended Practice," and with end sills 8 or 9 ins. in depth; for cars with these parts of different depth the proper adjustment can be made by changing the relation of the arms of the lever to bring the center of the eye of the horizontal arm to the proper height above the eye of the lock or by the use of links of different lengths.

There was practically no discussion on this report and upon vote of the convention it was decided to submit the recommendations of the committee to letter ballot as "recommended practice" of the Association.

The remainder of the second session was devoted to the discussion and amendment of the interchange rules, and numerous minor but not very radical changes were made. In some respects the modification ordered in the rules for billing the cost of small repairs was the most notable improvement made. This was, in brief, that no bill for less than 25 cts. should be rendered, and in case of repairs costing less being made the maker must wait until they aggregated 25 cts. before rendering a bill, but all such bills must be rendered within 60 days. In connection with this rule it was also voted that bills should not be returned for correction when the error involved was less than 25 cts., but that a claim for credit for the amount in error should be made and allowed, if just, on future bills. These changes had been recommended in a somewhat different form by the Arbitration Committee, but a committee of the American Railway Accounting Officers' Association being at the convention to urge the same measure, a special committee of Master Car Builders was appointed to confer with it and present a separate report. This special report was made the basis for the new rules. As is always the case, the modifications of the Interchange Rules brought out a great deal of discussion, all of which was pertinent and of value to the matter under consideration, but of very little interest to the general reader. A most notable fact in this discussion, considering the long battle of the advocates of the present rules to secure their adoption in place of the former code, was the almost unanimous expression of satisfaction with the operation of the new rules.

Third Session.

After receiving and disposing of a few minor questions left over from the preceding session, the convention turned its attention to the reading and discussion of special committee reports. The first of these to be taken up was that on "Loading Logs, Poles, Bark and Long Structural Material on Cars." This report was quite long and of such a nature that it is not practicable to give even an abstract here. Briefly stated, however, the report presented a practically new code of rules for loading timber, wood, bark, girders, pipe and all kinds of structural material, using one, two or more cars, and cars of different lengths and capacities. Drawings and instructions were given for blocking apart and connecting cars, and for supporting or binding the different classes of material to secure firm and compact lading. The nature of the report was such as to make discussion rather difficult, and after a few remarks from various members in commendation of the efficient work done by the committee, the convention voted that the new code of rules be submitted to letter ballot as "recommended practice."

The next report considered was on the parting or breaking in two, of freight trains in transit, and it was one of the most important of any presented. A preliminary abstract of this report was printed in Engineering News of June 10, and attention here may be confined to the discussion entirely, although this was quite limited and served to bring out but very little important information.

Mr. G. W. Rhodes, (C. B. & Q.) urged especially the importance of the clauses in the report calling attention to the slack in draft rigging as a cause of parting and the value of the buffer as a remedy. With a thousand cars equipped with M. C. B. couplers and also with buffers, which had been run together in special service on the C. B. & Q. R. R., it was noticeable that breaking in two of trains had caused little trouble, and further that but little deterioration of the draft rigging was shown. He was not prepared to choose between solid and spring buffers for metal cars, but with wooden cars he preferred the solid buffer. Several other members followed with remarks regarding the use of buffers which were not particularly pertinent to the question under consideration. Mr. J. E. Simons (Pitts. & L. Erie), and Mr. A. M. Waitt (L. S. & M. S.), spoke briefly against the location of the coupler unlocking attachments on the top of the coupler and urged the necessity of devising some form of unlocking attachment and of locating it in such a manner that it would not be hit by material falling off the car and would be entirely separate from the coupler.

Passenger Car Pedestal and Journal Box for 4¼ × 8-in. Journal.

The report stated that the committee had investigated the practice of various railways in respect to this question and had obtained the opinions of a large number of motive power officials, and from this information had designed a standard pedestal of the form shown here by Fig. 3. For passenger car journals the committee recommended the inside dimensions of the standard M. C. B., 4½ × 8-in. freight car journal box. This report of the committee was formally accepted, but no discussion of parlar value was brought out.

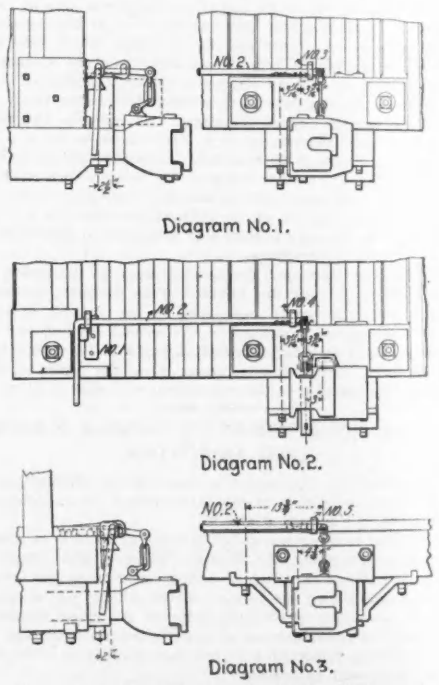


Fig. 2.—Diagrams Showing Application of Standard Unlocking Attachments to Different Car End Constructions.

Specifications for Cast Iron Car Wheels.

This report (which we printed last week) proved one of the best of any presented at the convention. The dis-

cussion turned largely upon the value and nature of the tests recommended, which consisted of two drop tests and a thermal test. In explanation of the report Mr. J. N. Barr (C., M. & St. P.) stated that it was intended simply to recommend suitable tests and let each company make all or any smaller number of these tests, as it chose. His personal opinion was that the thermal test was the proper manner in which to test wheels, as in it they were subject to somewhat the same conditions, viz., the heating of the tread by the application of the brakes, under which they most often broke. The manner in which a wheel

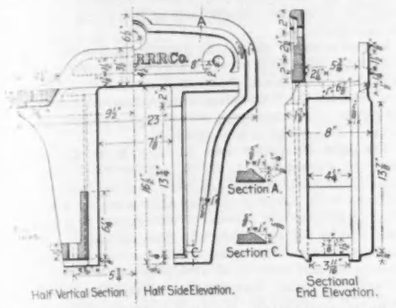


Fig. 3.—Standard Pedestal for 4¼×8-in. Passenger Car Journal, Recommended by a Committee of the Master Car Builders' Association.

broke under the thermal test depended much upon the temperature at which the iron was poured. Iron taken directly from the cupola cracked the wheel quicker if it cracked it at all, than if it was tempered down and poured at a low temperature. In certain tests, which he had in mind, wheels cracked under the thermal test in from 1 min. 10 secs. to 1 min. 15 secs., when the iron was poured very hot, but identical wheels cracked in from 2 mins. 10 secs. to 4 mins. 20 secs., with the iron poured after it had been allowed to cool for a few minutes. He believed either the drop tests recommended, or the thermal test, would ensure the selection of good wheels, but of the three, that the thermal test was the best.

Mr. W. W. Atterbury (P. R. R.) continued the discussion of the thermal test by quoting the results of some records kept by the Pennsylvania R. R. From May 1, 1892, to May 1, 1897, 6,446 wheels had cracked under the application of the brakes, and 242 wheels burst during the same period. These wheels were under both Pennsylvania R. R. and foreign cars, and represented wheels from nearly every prominent manufacturer in the country. Of these wheels, 754 cracked and 8 broken wheels were made at the Altoona shops of the Pennsylvania R. R. It was evident that there was something about the Altoona wheels which made them give better service. At present the Altoona wheels seldom failed under the thermal test. In conclusion, Mr. Atterbury made a motion that the specifications for tests recommended by the committee be changed so that the termal test and one of the drop tests should be required instead of any one of the tests alone, as originally stated by the report.

Mr. Pulaski Leeds (L. & N.) supported Mr. Atterbury's motion and stated that it was his custom always to test two wheels, one by the drop test and one by the thermal test. He had found that wheel makers and foundry men raised few objections and that he was securing better service from his wheels. After a little further discussion the motion was adopted.

Air Brakes and Signal Instructions.

This was a joint report of two committees appointed by the Master Car Builders' Association and the Master Mechanics' Association, which had for their duty a thorough revision of the "Instructions" for air brake and signal men. The report was quite long and was taken up nearly wholly by the new code of instructions in detail. In the discussion the proposed instructions received pretty severe criticism and it was finally voted by the convention to refer the subject back to the committees for further revision, the report to be presented at the convention of 1898. This finished the proceedings of the third day's session, except for a number of topical discussions, which will be considered elsewhere..

Fourth Session.

The first business of the fourth and closing session of the convention was the consideration of the report upon Improved Freight Car Buffers. This report was very brief and referred only to the ordinary solid M. C. B. buffer, the Gould buffer, and the Westinghouse improved draft gear, all well-known constructions.

Improved Freight Car Buffers.

The Gould buffer consists of two malleable iron cases, each containing a helical spring, having a capacity of 12,000 lbs. The total capacity of the buffer is therefore 24,000 lbs. A number of these buffers have been placed in service on the Lake Shore & Michigan Southern, and a few for trial on the New York, Lake Erie & Western and the Chicago, Burlington & Quincy R. R. The tests have been simply those for endurance in ordinary service, and the results in that respect have been satisfactory. The cost of cast-iron buffers, M. C. B. pattern, is about $3.90 per car; malleable iron, $4.40. The Gould spring buffers cost $15 per car. The capacity of the Gould buffer, 24,000 lbs., is only sufficient to absorb the work done by a loaded 60,000-lb. car, total weight 90,000 lbs., running at a speed of 1.08 miles per hour.

The improved Westinghouse friction draft gear has been in service on 50 coke cars for eight or nine months and has required slight repairs to but few of the cars. The committee witnessed a test of the draft gear on these cars, after eight months' service, on the southwest branch of Pennsylvania R. R. The loaded cars, having a total weight of 58,600 lbs. were thrown together at speeds approximately four to six miles per hour. Under such conditions the motion of compression was 2 to 2⅝ ins., and the capacity of the draft gear just about absorbed. A shop test of one of these gears was then made under a drop weighing 16,000 lbs., and it was found that a fall of 9 ins. just closed it through a motion of 2 ins. In order to get an approximate idea of the pressure required to produce an equal amount of work, a copper disk, 2½ ins. diameter and 2½ ins. high, was placed under the same drop and the weight allowed to fall 9 ins. The compression of the copper disk was 7-32 ins. A similar disk was then placed in a compression testing machine and it required 152,089 lbs. to reduce the height 7-32 ins. This can, therefore, be taken as the total capacity of the Westinghouse draft gear. As the spring resistance is 15,000 lbs., the value of the frictional part of the device is 152,089 − 15,000 = 137,089 lbs. It will be seen that more than nine-tenths of the resistance is by friction. As this is the controlling resistance, and as it acts in both ways, that is, in recoil in either direction as well as in compression, it will be evident that it exercises a braking action upon, and effectually checks the recoil of the springs. This recoil of spring action frequently causes trains to break in two and racks the draft rigging and car framing. To eliminate these destructive forces is the main object of the Westinghouse draft gear. The work done in compressing it, as shown by the drop test, is 16,000 lbs. × ⅜ ft. = 12,000 ft. lbs. The resistance of the standard draft spring is $\frac{19{,}000}{2} \times 1\text{-}6$ ft. = 1,583 ft. lbs. Now $\frac{12{,}000}{1{,}583} = 7.5$, which is the ratio of the resistance of the Westinghouse draft gear to that of the standard draft spring. This former will, therefore, absorb 7.5 times the shock absorbed by the ordinary draft spring. This draft gear is now being fitted to the 600 steel cars, 100,000 lbs. capacity, building for the Pittsburg, Butler & Lake Erie R. R.

The discussion on the report was quite brief. Mr. G. W. Rhodes (C., B. & Q.) and Mr. R. P. C. Sanderson (Norf. & Wn.) both spoke in favor of the solid M. C. B. pattern of buffer for wooden cars as being cheap and efficient. Mr. Rhodes considered that the shock did not have to be very great to close the spring in either of the patented devices shown and that when this point was reached, neither was anything but a solid buffer. Mr. A. M. Waitt (L. S. & M. S.) called attention to the fact that in the Gould buffer the shock was in the plane of the center sills and car frame, and in this respect he believed it to present advantages over the Westinghouse gear. Upon motion of Mr. Waitt the M. C. B. solid buffer was submitted to letter ballot as a standard of the Association.

Box Car Side and End Doors.

A circular of inquiry issued by the committee brought replies from 28 railways representing 202,000 box cars. Companies representing 180,000 box cars were in favor of the common batten door, while the balance favored either frame or flush doors. In regard to the style of hangers, companies representing 90,000 box cars were in favor of overhung doors, with roller hangers not patented, and the remainder, representing 112,000 cars, favored either the common slide hangers or various patented forms of hangers. Basing their work upon these replies and the necessity of not infringing any patents the committee worked out a design which it described as follows:

The side and end doors to be hung by two cast or malleable iron hangers to each door, each hanger secured to the door by three ⅞-in. carriage bolts and two ⅝-in. dowels, tapering to ½-in. Each hanger to be supplied with a chilled cast-iron roller fitted into the hanger. The top rail to be ⅞ × 2½ ins. wide, backed by a piece of oak running full length, being about 1⅛ ins. horizontally and 1⅜ ins. vertically, the rail to be fastened to this oak strip and through side or end plate by ½-in. countersunk bolts, about 20 ins. apart. The lower edge of door to have an iron rail ⅝ × 2½ ins., rabbetted flush into the lower cleat and projecting 1 in. below the bottom edge of door, and fastened with button-head countersunk rivets ⅞-in. in diameter, passing through the ⅝-in. iron rail, bottom cleat and sheathing of door. These rivets to be about 18 ins. apart; also two button-head rivets ½-in. in diameter, passing through the ⅝-in. iron rail, ⅝-in. from bottom of rail, and so located that the button heads will come in contact with the door brackets when the door closes, thereby holding the door tight against the car body.

It is the opinion of your committee that it would be useless to recommend a standard size of door, as the door will have to correspond with the door openings of the various sizes of box cars. The recommended door, however, is the common batten door, with three pine cleats 10 ins. wide, and located at top and bottom edges and center of door on the inside, and filled in on the two side edges by filling strips 5½ ins. wide, the door to lap 2 ins. on closing side against an oak stop strip, running full length of door and fastened to the door post by ½-in. lag screws; the door to lap on door post on opposite side of door at least 4 ins. The door fastenings for seal to be the common hasp and eye bolt, in connection with the seal pin and tin seal, and located a suitable distance from bottom edge of door. Taking everything into consideration, your committee is of the opinion that the most practical end door fastening is that which fastens on the inside, requiring no seal, thereby saving considerable labor to the sealing clerks and the trainmen in inspecting same. In conclusion, your committee recommends that the standard side and end doors for box cars, including fixtures, top and bottom rails, seal pins, brackets, etc., be in accordance with that illustrated in the cuts presented herewith.

No discussion followed and upon vote of the convention the design presented by the committee was ordered to be submitted to letter ballot as "recommended practice."

Arch Bars and Column Bolts for Diamond Trucks.

This committee was appointed to recommend forms and cross sections of arch bars and column bolts for trucks under 60,000-lb. cars and also designs and sizes for similar parts for 80,000-lb. car trucks. For 60,000-lb. cars the sizes recommended were as follows:

Wheel Base.	Distance bet. top and bottom arch bars at column bolts, ins.	Cross sections bars—Arch bar, Top, ins.	Arch bar, Bottom, ins.	Tie bar, ins.	Diam. col'mn bolt, ins.
Between 5 ft. and 5 ft. 6 ins.	14½ to 16½	1⅛ × 4	1¼ × 4	½ × 4	1⅝
	16½ and greater	1¼ × 4	1⅛ × 4	½ × 4	1⅝
5 ft.	14½ to 16½	1¼ × 4	1⅛ × 4	½ × 4	1⅞
	16½ and greater	1⅛ × 4	1 × 4	½ × 4	1⅝
Less than 5 ft.	14½ to 16½	1⅛ × 4	1 × 4	½ × 4	1¾
	16½ and greater	1 × 4	⅞ × 4	½ × 4	1⅜

For 80,000-lb. cars the sizes recommended were: for top bar 1½ × 4½ ins., for bottom bar 1⅛ × 4½ ins., and for tie bars ⅝ × 4½ ins. In respect to the material used the report said:

In recommending these sizes, it is assumed that material of good quality is used. Wrought iron or steel having a tensile strength of 50,000 to 55,000 lbs. per sq. in. and an elongation of 20% on a section originally 2 ins. long, would satisfactorily fill the requirements. Material having a tensile strength of less than 48,000 or more than 60,000 lbs. per sq. in., or showing less than 15% elongation on a section originally 2 ins. long, or if the test piece shows a granular fracture covering more than 50% of the fractured surface, should not be used. The material should also be free from cracks or fractures when bent to the required forms.

There was no discussion and the convention voted to submit the recommendations to letter ballot for adoption as "recommended practice" by the Association.

Steel Underframing for Freight Cars.

This committee of five members was appointed to present individual designs for standard steel underframes for freight cars, and five designs were presented, two by R. P. C. Sanderson (Norf. & Wis.), two by G. R. Joughins (Norf. & Sou.) and one by J. N. Barr (C., M. & St. P.). Space will not permit the illustration of these designs here. Briefly described, they were all for 60,000-lb. capacity, 34-ft. cars, 8 ft. 4 ins. wide inside, 7½ ft. from floor to top of plate, and 4 ft. 2 ins. from top of floor to top of rail. The committee recommended the adoption of these dimensions by the Association and said:

It is particularly desirable, whatever design of steel underframe be adopted as standard or as recommended practice of your Association, even if the detail of the fastenings and less important parts be left to the individual choice of the builder, that the length, section and weight of the main sills, end sills, draw gear and bolster be shown on the Association's drawings, so that the rolling mills and car builders who wish to take up the question of manufacturing the steel frames for 60,000-lb. capacity cars can take advantage of market fluctuations to buy stock when prices are low, with the assurance that the size and length of sills will surely be used by any railway companies ordering freight cars with steel frames, and further, that the stock of sills carried by railroads for their own use can also be depended on to suit any steel-framed interchange freight car that may be damaged on their line. Therefore, in presenting these drawings for the criticism, choice, and, we hope, approval of your Association, we earnestly urge that the dimensions for a standard interchange freight car mentioned above, to which these drawings have been made to conform, should be submitted to the Association by letter ballot, for adoption as standard, and that the Association will make a choice of one of the designs presented and adopt it or its leading features and dimensions as recommened practice.

In the discussion Messrs. Barr, Joughins and Sanderson spoke in favor of their special designs and urged the continuation of a committee to report on the same subject at the convention of 1898. By votes of the convention a new committee was appointed to consider the subject, and the general dimensions for freight cars recommended by the present committee was submitted to letter ballot for adoption as "recommended practice" by the Association. This was the last of the special committee reports on the programme, and the convention turned its attention to the topical discussions.

Topical Discussion.

The noon hours of the first, third and fourth days' sessions of the convention were devoted to the discussion of topical questions suggested by the committee on subjects. Some of the more valuable and interesting of these discussions will be given here, without attempt to keep the sequence of their discussion by the convention.

Thermal Tests of Wheels.

Mr. G. L. Potter (Pa. Co.) introduced this subject with the following paper:

During recent years the competition in railway business has resulted in a marked increase in the speed and size of trains and in the size and carrying capacity of the cars. These new conditions developed weaknesses in some parts

of the equipment and made it necessary to devise means that would reduce the failures of the important parts to the minimum. One more or less serious cause of wrecks is due to the breakage of wheels. In some cases the failures are due to want of proper inspection, whereby wheels which are worn through the chill, or have seams in the tread, or other defects, are allowed to remain in service longer than they should. There is, however, one cause of breakage of wheels that the most careful inspection cannot prevent, namely, that due to the expansion of the tread caused by long and severe application of the brakes, frequently necessary on long, steep grades or in controlling heavy fast trains with a few air brake cars, resulting in the tread becoming very hot, causing it to expand, thereby introducing strains in the wheel which it cannot resist.

In considering the subject with a view to overcoming failures from this cause, it was thought that the introduction of specifications requiring representative wheels to stand a test which would bring upon them the same strains that are produced by severe brake application, would result in producing wheels that would be safe to use under the most trying conditions. Such specifications, which are similar to those recommended by the committee appointed to report to this convention on "Specifications and Guarantees for Cast Iron Wheels" (Eng. News, June 10), have been in use on the Pennsylvania lines for a year or more, with very satisfactory results. The manufacturers experienced some difficulty at first in meeting the requirements of the specifications, but soon found that by the use of the proper metals and care in annealing, the difficulties could be readily overcome.

The carrying capacity of freight cars having increased in a much greater ratio than the weight, and as the braking power that can be used on such cars is limited by the light-weight of same, and with the greater speeds of today, the wheels receive much more severe punishment from the brakes than formerly. Also, as the amount of double tracks is constantly being extended, making it still more necessary to take additional precautions to prevent wrecks on account of the possibility of trains on the other track being wrecked also, wheels furnished under specifications requiring such a thermal test as is now in use and as proposed by the committee, will surely be safer to use than those furnished under no specifications or specifications requiring only a drop test, which subjects the wheel to shocks that it seldom, if ever, receives in service. It has been advanced that it is possible to make wheels that would meet the thermal test, but that owing to the nature of the metal used (it being too soft or having other properties that would prevent its chilling properly) would not necessarily give good service in so far as wear is concerned, but this can be provided against by requiring the maker to guarantee the wheels to give a proper time or mileage service.

Laboratory Bureaus for Railway Companies.

Mr. R. P. C. Sanderson (Norf. & W'n) presented the following short paper on this subject:

With the increasing railroad competition, decreasing earnings and hard times generally, economies have become more and more important. One economy, which is of supreme importance to railroads and is becoming more and more recognized, as indispensable by progressive railroad managers, is to obtain the very best possible materials for the least possible money, or, to obtain a material that is good enough for the purpose and is cheaper than something that may be unnecessarily better. The general manager of a small railway feels that he has the same urgent need for more or less scientific and practical administration in his motive power department, as, has the general manager of a large railway, but he cannot afford to establish a laboratory for testing materials, for the small amount of this business that is to be done on his road. He would unquestionably prefer to purchase materials on specification, but as he cannot test them, feels that it is a farce to make specifications and afterwards not to know whether they are lived up to.

It would be a great boon to the managers and motive power officials, of large and small railways, if some plan could be devised, whereby facilities for testing materials, such as are generally used by railroads, could be readily provided at small cost. The equipment of a laboratory is a very expensive undertaking, and after having accomplished this it is not a very easy thing to obtain a man to take charge of it who is sufficiently well trained in analytical work to be really useful, at anything like a moderate salary from a modern manager's standpoint, and for a small railway it is doubtful whether the expenses could be justified by the saving to be effected as a result of this work. From a manufacturing or supply man's standpoint, it ought to be, and I believe is, much more satisfactory to manufacture and sell materials on a definite specification, which means a clear understanding as to what materials actually are, than to make or to sell materials on indefinite promises, such as "being the best of their kinds" "or "quality" or "the best in the market"—to find then that the materials didn't give satisfaction because they were really not what was wanted or because the agent did not fully understand, at the time the purchase was made, what the actual requirements were.

I believe it is possible, nay, practicable to establish at a half dozen or so conveniently located railway centers, well equipped chemical and physical laboratories for the purpose of testing paints, oils, metals, soaps, etc., in charge of competent men with competent assistants who should be paid good salaries to obtain the best talent; these Laboratory Bureaus to be under the charge of a board of directors or executive committee appointed by the railways and to be equipped and supported by an initiation fee and annual dues paid by the roads on some equitable basis: say, the number of cars or engines owned by each company. The contributions paid to be so regulated that they will just meet the equipment, repairs and fixed charges of the establishments and a definite schedule of charges for analysis and tests to be established so that the roads making most use of the laboratory would pay in proportion to the benefit received.

It may be suggested by suspicious persons that the men in charge of such laboratories would be open to corruption, and it would be doubtful as to whether reports made could always be depended on. It is, however, a very simple matter to ensure that the analyst should know nothing of the source from which the materials he is working on came. Samples for analysis or test should bear no trade mark, and should always be sent by the railway company and not by the supply firm, and should simply have a designating mark or number to be registered by the railway furnishing it. If any railway company were dissatisfied with the results of any test, or analysis, a system of cross testing could be devised, whereby the men in charge of some other laboratory could have corresponding samples furnished him for test, bearing different marks. By this means effective work could be done at a very small cost, and I believe that even large railways would find it to their benefit to abandon their own testing departments and use the general laboratory. It is likely also that with the experience gained in these laboratories, standard specifications for different railway supplies could be prepared by the men in charge, to be submitted to the executive committee for their approval and voted on at the annual conventions for standards.

Far greater uniformity in manufacture and better quality of materials would unquestionably be the results of such arrangement, and it is believed that considerable reduction in the general cost of materials purchased would be one result, while a second one would be that the manufacturing and selling of railroad supplies would be a much more satisfactory and profitable business.

The discussion was continued by Mr. G. W. Rhodes (C., B. & Q.) and Mr. C. A. Schroyer (Chic. & No'w'n), both of whom spoke highly of the value of the testing laboratory, in selecting the numerous supplies and materials used by railways.

Copper Sheathing for Passenger Cars.

This question was brought up by Mr. W. C. Appleyard (N. Y., N. H. & H.) and excited unusual interest from the members. In a few opening remarks and in reply to questions, Mr. Appleyard gave the following information regarding this interesting experiment:

In December last we selected one of our first-class cars and had the sheathing removed. We redressed and blocked the frame and prepared the metal sheathing for the car. The process was slow in the case of the first car, as we had to feel our way. We used our standard passenger car sheathing, except that in this case we made it somewhat thinner than usual. We thought the copper would add considerably to the weight of the car. Since the completion of the car we have found that it is not desirable to thin sheathe it, for the reason that the lips of the grooves in the edge of the sheathing are inclined to curl somewhat, there not being lumber enough in the upper lip to make it stable. All the posts and corners, in fact every exterior portion of a passenger car commonly made of wood we sheathed with copper. The gage of the copper was No. 28, but if we were to continue we would use No. 30, which would work somewhat better and lessen the weight considerably. The car went into service last January. It was oxidized by a solution commonly used for such purpose. It was put on one of our Shore Line fast trains and has continued in service without interruption. The effects of yard treatment, in cleaning, have been uniformly satisfactory. It costs much less in labor to clean the car. The copper is put on in exactly the same way as the ordinary wooden sheathing. The cost of the car as nearly as we can calculate would reach about $50 more than treating the car in the usual fashion. That cost was due somewhat to the slowness of the work. It will require about 800 or 900 lbs. of copper to the ordinary passenger coach. The present price of copper is 15 cts. a pound. The great saving is in the shop space and time required to do the work. As the metal sheathing can be applied to an old car as well as a new one, the saving can be reckoned easily. We have had no appreciable evidence of any expansion. We sent the car out in cold weather, and it has seen a few very hot days, but there appears to be no change on the car. The stiffness of the material would prevent any bad appearance on the board.

Samples of this copper sheathing were exhibited by Mr. Appleyard and were carefully studied by the members. At a passing glance the sheathing would not be distinguished from the regular Pullman paint and varnish finish, used on the regular Pullman parlor and sleeping cars.

The advantages to be gained by using M. C. B. air brake defect cards was a subject introduced by Mr. Thos. Fildes (L. S. & M. S.), who stated that he had used a card to which had been added a list of a score or so of items of injury or derangement most commonly found in air brakes. This card was used by the trainmen who, when trouble occurred with the air brake in transit attached the card to the defective car with the item naming the particular defect existing crossed out by pencil. By this system when the car reached an interchange point the inspector knew at once where to look for the trouble, and, similarly, repairs could be made without going to the trouble of hunting all over the air brake fixtures, as would be necessary if the car was simply marked as defective without any definite location of the defect being made. Messrs. G. W. Rhodes (C., B. & Q.), A. M. Waitt (L. S. & M. S.), W. S. Morris (Ches. & Ohio), and others spoke in favor of this system as saving time and labor in making up trains and repairing defects in air brake equipment.

The next question was brought up by Mr. G. W. Rhodes (C., B. & Q.) and was: Whether it is safe and practicable to splice air brake hose? Mr. Rhodes stated that he had used for some time a malleable iron nipple and collar splice for air brake hose with good results in practice and a great saving in hose. These splices cost 7½ cts. each, and he had found by actual count that these splices had resulted in a saving of 200 new hose monthly at one of his shops alone. There was one objection which might be urged against splicing, and that was that it introduced an additional joint in the air pipe; but he had experienced no trouble from this source. He wished, however, to distinguish between splicing and patching hose. Patching was not satisfactory. Mr. J. N. Barr (C., M. & St. P.) stated that like Mr. Rhodes he had used spliced hose with very satisfactory results. After some further discussion, it was voted as the opinion of the members present that the splicing of air brake hose was a proper and safe practice.

Following the same general subject Mr. A. M. Waitt (L. S. & M. S.) brought up the question of specifications for air brake hose. He had found that but few railways had such specifications, but believed they would be advantageous in securing better hose. The 24-month guarantee of hose he considered of little value. He had adopted a system of testing hose which he regarded as very successful in showing its quality. It was simply to saw out a ring ¾ in. wide from the hose and then by means of a spring balance ascertain how much of a pull it took to peel the duck from the rubber. He had found that the strength of the pull was a very good indication of the quality of the hose as experienced in actual use. He found too that a good elastic rubber was an important essential in the durability of hose, and this could be determined by the very simple test of stretching a strip of the gum cut from the hose until it broke. Mr. H. M. Carson (Pa. R. R.) confirmed Mr. Waitt's statements as to the value of these very simple tests and as to the durability of specifications.

The advantages of making journal boxes with round instead of square bottoms was brought up by Mr. S. P. Bush (Pa. Co.), who stated that round bottoms had been made standard on the Pennsylvania lines, because first the construction is a lighter one, second it is stronger, and third it takes less waste to pack the box.

Mr. John Mackenzie (N. Y., Chic. & St. L.) spoke in favor of having an M. C. B. coupler defect card. He stated that such a card had been used on the New York, Chicago & St. Louis R. R. for some time for the purpose of determining the causes of uncoupling in transit. It was used by the trainmen, who filled out the card and sent it to the main office. As a result of the study of these reports he had found that over 90% of the break-in-two's of trains in transit was due to poor coupling by the trainmen.

A number of other questions and propositions were brought up and briefly discussed by various members, but are not of sufficient general interest to be presented here. As a whole the topical discussions furnished some of the most interesting business of the convention. The result was due very largely to the fact that the duty of presenting each question and giving the reasons for presenting it, had been assigned in each case to some one member, generally the member who had suggested the question, who become its sponsor, so to speak, and did his best to call out discussion and comment.

Election of Officers.

The closing hour of the fourth session of the convention was taken up with the election of officers and the presentation of resolutions and other routine business. The following officers were elected: President, S. A. Crone (N. Y. C. & H. R.); First Vice-President, E. D. Bronner (Mich. Cent.); Second Vice President, C. A. Schroyer (Chic. & No'w'n); Third Vice President, J. T. Chamberlain (B. & M.); Treasurer, G. W. Demarest (North. Cent.); Members of Executive Committee, W. S. Morris (Chesa. & Ohio), Samuel Higgins (Lehigh Valley) and C. M. Mendenhall (P., W. & B.).

The committee, consisting of Mr. A. M. Waitt (L. S. & M. S.), Mr. J. T. Chamberlain (B. & M.) and Mr. C. A. Schroyer (C. & N. W.), appointed to suggest subjects for committee reports at the convention of 1898, submitted the following:

(1) Injury to track and trucks from salt water drippings from refrigerator cars and best method for its prevention.
(2) Trains parting (continued).
(3) On the improvement and perfection of the top hinge lid, so that it may completely exclude dust from journal boxes.
(4) On the modification of the standard journal boxes, to adopt them for use in trucks (whether for passenger or freight cars) involving the use of pedestals.
(5) To consider the question of defining the length and spread of the guard arm of the automatic coupler.
(6) To consider (jointly with a committee of the Master Mechanics' Association) whether the standards of the associations in the matter of square bolt heads and nuts ought in any way to be modified.
(7) Air brake hose specifications. To consider the prevailing conditions connected with the manufacture and use of air hose and the necessary requirements to insure hose being properly made.
(8) Standard coil springs for freight car trucks.
(9) To consider the practicability of establishing test bureaus for railway companies.
(10) The value of thermal tests for car wheels and how they should be conducted.
(11) To consider the best method for packing and care of journal boxes.
(12) Joint Committee of M. C. B. Association, American Railway Association and Master Mechanics' Association to further consider the revision of air brake and signal instructions.
(13) Committee to consider further and report designs for steel framing for freight cars, and to obtain criticisms on designs furnished by joint committee.
(14) Is it desirable to have a uniform system of indicating on defect and repair cards the exact location of defects? If so, what is the simplest way of accomplishing the desired result?

In presenting this list of subjects the committee said:

Your committee would call the attention of the members to the fact that with many subjects the burden of work necessarily falls on the chairmen of the committees, and as some of the topics can readily be made the subject of individual papers, we would recommend that the Executive Committee consider the advisability of assigning some of the subjects each year for individual investigation and papers on the results of such investigation.

Exhibits and Excursions.

As usual, a large number of firms had their wares on exhibition, and in so far as we have been able to secure their names these firms are mentioned under "Industrial Notes" in our Construction News supplement this week. The Supply Men's Association provided its usual rather lavish supply of entertainments for the members present.